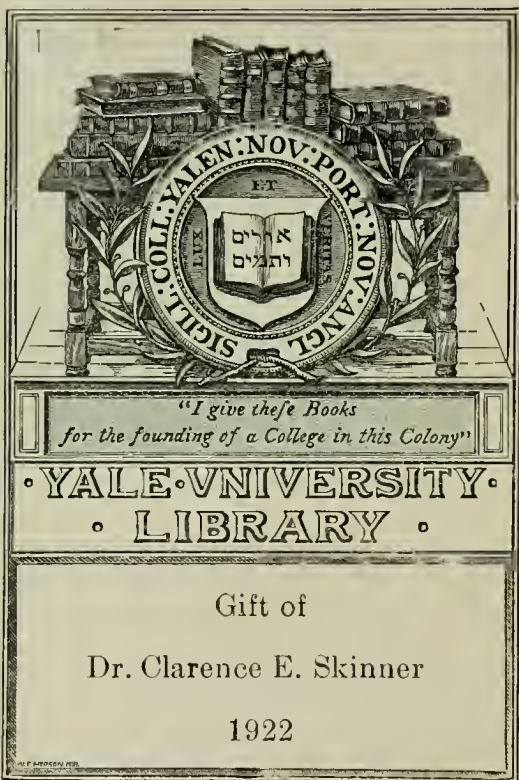


YALE UNIVERSITY LIBRARY



3 9002 06747 5930



TRANSFERRED TO
YALE MEDICAL LIBRARY

Practical Electro-Therapeutics

BY

FRANKLIN B. GOTTSCHALK, M.D.

949

Professor of Diseases of Children at Jenner Medical College;
Attending Physician German - American Hospital;
Assistant to Chair of General Medicine Chi-
cago Polyclinic; Member Ameri-
can Medical Association;
Chicago Medical
Society, etc.



PUBLISHED BY

T. EISELE, 906 EVANSTON AVENUE

C H I C A G O

COPYRIGHT 1904, BY
FRANKLIN B. GOTTSCHALK, M. D.

PRESS OF
BLAKELY PRINTING CO.
CHICAGO

RM 871
904 G

PREFACE.

This book contains a concise presentation of the most important modes of treating patients by means of electricity, a knowledge of which the busy practitioner may acquire more permanently through good illustrations than through the most elaborate descriptions. It has been written with the idea of bringing forth facts, and facts only, for a clear comprehension of the topic under discussion.

The author is a thorough believer in drugs, hygiene and diet, but believes that, by the application of the principles here laid down, results may be obtained which appear marvelous to one not familiar with their application. The combined effect of drugs, electricity, the electric light baths and vibratory stimulation seems at times almost magical in the instant relief brought to the patient.

INTRODUCTION.

While our conception of the nature of electricity is largely theoretical, we by no means lack positive knowledge concerning its actions and the laws that govern them. Great progress has been made in utilizing this agent in the arts, and by means of electro-therapeutics maladies are now cured that were formerly not amenable to treatment.

There is only one kind of electricity, no matter how generated, but its actions vary widely according to the current and instrument used in employing it.

Investigators have demonstrated that both animal and vegetable life are due and dependent upon electric conditions, and it is more than likely that the organs of active nutrition give rise to electric currents. It is also true that animal organs and tissues are modified and influenced by electricity.

There are many reasons why the work of the nervous system should be compared with the complex workings of an electrical battery. In health the nerves are all in a state of vibration, due in all probability to the electrical currents which traverse the body in every direction. When it loses its vibratory function, death and degeneration ensue. The various nerves respond to different vibrations. The optic nerve responds to very rapid vibrations, while large waves stimulate the nerves of the ear, etc.

Electricity has become the mainstay of the neurologist, both in diagnosis and treatment. It

is one of his most important tools. The more familiar we are with its manifestations, the more we recognize its adaptation to the requirements of a disordered physiological condition. By means of electricity we frequently get a knowledge of the probable duration and curability of certain diseases, which we never could obtain in any other way. The value of this is evident, when we reflect that the correct determination of the polar responses of a muscle of a limb may mean a verdict of cerebral disease on the one hand, or a trifling pressure paralysis on the other. Again it is of great medico-legal value in determining the presence or absence of lesions due to accidents.

For the intelligent use of electricity it is absolutely necessary to know the elementary principles and have a clear knowledge of the physiological action of the different currents on the human system. If the nature of electricity is only imperfectly understood it is ridiculous to attempt to use it, for being a potent agent it may do much harm if not properly employed. It is better not to employ it at all than to use it without a clear knowledge of its physiological action, for, like strychnine, it may be valuable if given when indicated and in proper dosage, and vice versa.

By its careful study and application many ailments may be relieved and heroic operation will frequently become unnecessary.

If we wish mechanical effects we select the currents of alternation with a to-and-fro motion. For a chemical effect a current of considerable amperage is necessary, while physiological effects may be excited by every possible manifestation of electricity.

Idiosyncrasies, here as elsewhere, play their part. Some patients react better to one form

of electricity than to another; while other patients, suffering from the same apparent pathological condition, and for no apparent reason, react better to other forms.

The large majority of patients who apply for electric treatment are chronic cases and require chronic treatments. Relapses are apt to occur just the same as those following surgical or medical treatment.

The source of many disorders is oftentimes found outside of the boundaries of the structure affected, and the therapeutic measures to be successful must be directed so as to control and correct the beginnings of the morbid processes.

The nervous system is made up of individual elements termed neurons, together with neuroglia, connective tissue, blood vessels and lymphatics; and diseases that pertain to it must affect one or more of these structures. These tissues are not many, nor are the pathological processes that arise in them numerous. According to the location or function of the tissue involved, we have a large variety of clinical pictures and it is only proper to approach these troubles from a physiological and anatomical rather than from a symptomatic standpoint.

The author believes that if the elementary principles of electro-therapeutics are thoroughly understood the physician will be able to make the applications that are necessary without more definite explanations than are found in this work.

Our physiology tells us that to keep an organ in perfect repair we must have a perfect circulation. Disease really means a stagnation of the circulation in that particular part. A congestion anywhere is a detriment to the organ concerned. Our bodies are run on strictly business principles. Money hoarded is of no value. It only increases in the channels of trade, and blood,

like money, is of no value unless in circulation. We can only build up our vitality by using the means at our disposal just as does a business concern. We can only distribute; we can create nothing of the human principle, except out of the surplus. Surplus means growth.

There is enough energy going to waste in the healthy mortal to build up a helpless organ. Electricity affords us a means of directing this surplus energy to the diseased portion of the body.

Of all physical measures used in therapeutics, there is none that permits the use of suggestion along with it as well as does electricity. The patient is usually resting quietly while the current is passing, with the mind in a perfectly passive and receptive condition. Instructions in regard to habit, physical exercise and diet, being daily and frequently repeated, are adopted as fixed thoughts and not easily forgotten. These are of much value, as it brings about the earnest co-operation of the patient.

ELECTRICITY AND ITS GENERATION.

Recent research has proven that electricity pervades all space, possesses no inertia and moves without friction. It transmits energy and motion. Light, heat, electricity and magnetism are all transmitted through space by some active condition of ether, either longitudinal or horizontal vibrations.

We cannot produce electricity any more than we can produce a current of water, but we can produce pressure somewhere in the circuit and thus cause it to be set in motion, and are able to regulate its flow.

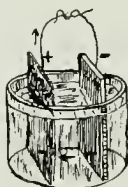
Electricity may be compared with the flow of water in pipe which connects two reservoirs containing water at different levels. Water flows from higher to the lower level. The greater the difference in levels the greater the pressure and consequent flow of water. Water flows faster through a short than through a long small pipe.

Similarly, the greater the pressure or electromotive force the stronger the current, and the greater the resistance of the circuit, the less the current.

The commercial current, due to its almost unvarying uniformity is the most desirable to those who have access to it. It can be used for the purposes of galvanism, faradism, cautery and sinusoidal. When this current is not available the current may be produced by decomposition, or the conversion of chemical energy into electrical energy.

It has been proved that when two dissimilar substances are placed in contact, one of them al-

ways assumes the positive and the other the negative condition, though the amount of difference may be small and difficult to measure. Placing copper and zinc in contact develops a difference in potential easily detected. The same results hold true if the plates are slightly separated and immersed in a saline or acidulated solution (voltaic cell). The exposed ends of the plates are now charged to different degrees of electrical potential, one plate being higher than the other. When the exposed ends are connected by a conducting wire the difference tends to be equalized by a rush from one pole to the other, its passage being through the liquid. In



Voltaic Cell.

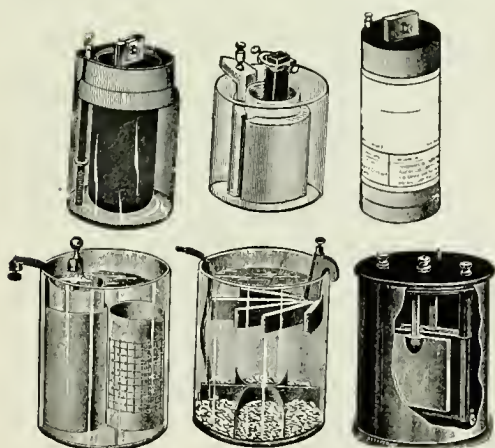
passing through the liquid, certain chemical changes take place. These in turn cause a new difference in potential, and follow one another with great rapidity, in fact too fast to be distinguished, appearing to be continuous. This equalizing flow, constantly taking place, is known as the direct current. It only becomes continuous when the difference in potential is maintained and no device is employed to interrupt it.

The chemical compound or solution which undergoes decomposition when traversed by an electrical fluid is known as an *electrolyte*.

The polarity of that end of the plate which is acted upon by the electrolyte is always of opposite sign to its terminal as seen in the illustra-

tion. Whenever a connection between the exposed ends is broken the action ceases until they are again connected. In any voltaic cell the element acted upon by the electrolyte is the generating plate and its electrode is always the negative.

The current flows from the higher to the lower level. The high point is always the anode or positive, and the low point is always the cathode or negative.



Different Varieties of Galvanic Cells.

Within the cell the zinc is the positive element. The current flows from it to the carbon, but outside of the fluid this is reversed, the carbon terminal being the positive and the zinc the negative pole.

The larger the surface of carbon and zinc exposed to the action of the excitant the greater the energy developed. The decomposition taking place at the zinc makes it the generating plate. The positive electricity generated there,

flowing through to the carbon, which is of lower potential, is carried out of the cell through the conducting wire.

It is not an easy matter to select the proper cells for medical purposes; portable dry battery cells are preferred by some, but they have a distinct disadvantage because when exhausted they must be replaced by new cells. For office work those cells using a saturated solution of ammonia chloride are to be preferred, as the elements may remain in the fluid and do service for a long time and can be placed in closet or basement. In the cells using bichromate of soda and sulphuric acid, the elements must be removed from the fluid when the battery is not in use, as zinc is consumed as long as it is immersed. The sulpho-chromic battery is portable, but the fluid should be carried in a separate receptacle to prevent its splashing over.

Battery Solution—

Bisulphate of mercury. $\frac{1}{4}$ pound.

Bichromate of soda. . . . 1 pound.

Add two quarts of water—stir and add one quart of commercial sulphuric acid, pouring the acid in slowly. Add enough water to make one gallon, and set aside to cool. Used hot it destroys the zincs very rapidly.

When communication is established between the elements in the fluid, large quantities of hydrogen bubbles collect around the carbon element, neutralizing the original flow of current. The larger the carbon surface the longer it takes to cover it with hydrogen. A cell in this condition is said to be polarized. It is of utmost importance to remove this hydrogen either by mechanical or chemical means. The chemical must be one with which the nascent hydrogen combines and is one usually rich in oxygen.

When acids enter into the composition of an electrolyte there is apt to be trouble on account of tendency to oxidize the metallic surface connected with the cell. All oxides are poor conductors and should be cleaned with a piece of emery cloth. Contact surface must be free from dust and be bright.

The zinc must be amalgamated to prevent this local action. Iron must be separated from the



Portable Galvanic and Faradic Battery.

zinc and made harmless. Before amalgamating, the zinc must be dipped in an acid bath which removes impurities from the surface; then mercury is rubbed in with a cloth or a piece of galvanized iron, and when finished should be bright as silver. It is a peculiarity of this amalgam that it does not leave the zinc when the latter dissolves, but immediately attaches itself to fresh portions of the same. If a hissing noise

is heard when the zinc is placed in the electrolyte it signifies that the zinc needs re-amalgamation.

A *storage battery* is an apparatus in which certain materials are so arranged that when a current is passed through it these materials so or pressure. Medical work requires a pressure arrange themselves as to be able to act as a voltaic cell and by chemical action produce electrical energy. These so-called storage batteries store energy, but not electricity.

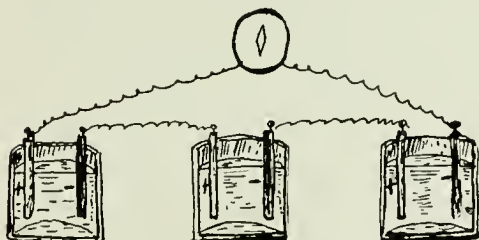


Chloride of Silver Dry Cell Battery.

The manner of connecting the cells together depends on the kind of work required. In treating the human body, which offers considerable resistance, our desire is to increase the voltage of twenty volts for the slightest current and about one hundred volts for the more heavy current. This pressure may be obtained by connecting the cells in series, connecting the unlike elements of the cells, as per illustration.

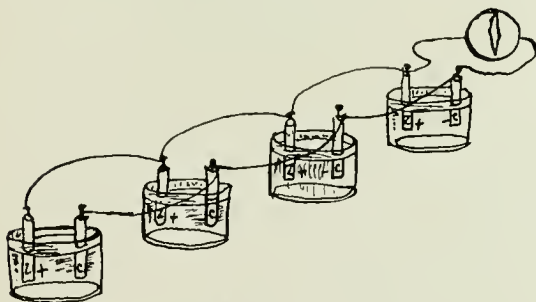
For instance, from forty cells of one volt each we have a pressure or push power of forty volts,

or as many cells as we have in the circuit. Sixty-six cells, of a volt and one-half each, give one hundred volts. All the cells, thus connected in series, will not give current enough to heat



Cells Connected in Series.

an ordinary cautery knife because we cannot obtain more current than from a single cell, its output being limited to its own internal resistance. If this arrangement is reversed we have



Cells Arranged in Parallel.

an increased quantity of current or as many amperes as cells, and but one volt of pressure. The internal resistance is overcome by connecting the cells in parallel, that is, all the carbons are connected together as the one positive pole and

all the zines as the negative, practically making them one enormous cell many times larger than the original, just the same as increasing the cell thirty, forty or fifty times, according to the number of cells used. This gives us the desired amperage, but a very low voltage.

A battery works best when the internal and external resistances are the same. If the resistance is doubled the amperage is halved and half of its power is spent in the battery.

ESSENTIALS.

Though our knowledge of the nature of electricity is limited we can measure it and control it.

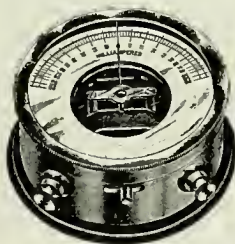
A *coulomb* is the measure of quantity, the same as a gallon is the measure for water. The use of this term is very limited in electro-therapeutics. A *milliecoulomb* (one one-thousandth of a coulomb) is the unit of quantity consumed in a medical current.

Amperage.—By amperage we mean the rate of flow. An ampere is the unit of current strength flowing through water, which will liberate 0.0000105 grams of hydrogen in one second.

By *voltage* we mean the difference in the electrical level, as for instance in placing two tanks filled with water, connected by a tube, on different levels. It is the force or push power. The human skin offers high resistance to electricity. With the ordinary sponge disk thirty volts are necessary to force a current into the tissues. The larger the quantity of electricity the less resistance is offered. As only a certain quantity of electricity can be forced through each square inch of surface with a given number of cells, the number of cells must either be increased or the area of the electrode. A large

electrode should be used where a large current with little pain is desired. The resistance varies in different parts of the body according to the texture of the skin. Tissues underlying the fascia are fairly good conductors.

An ohm is the resistance offered to the flow of current by a copper wire one-twentieth of an inch thick and 250 feet long. A current cannot flow through any conductor without losing some of its pressure. The current is always reduced by the resistance of the conductor through which it flows, determined by the substance of which this conductor is made. Length of wire increases the resistance, while thickness of wire decreases



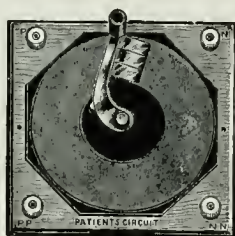
Milliammeter.

it, just as the small pipe will carry less water than a larger one. To illustrate—In a fountain syringe full of water this pressure at the nozzle may be compared with the voltage, the pressure depending on the length of the tube and the height at which the bag hangs above the point of the nozzle. The longer and smaller the tube the greater the resistance, likewise, the longer and thinner the conducting wire the greater the resistance. Just as a pipe with a large lumen decreases friction, so a thicker wire decreases the resistance of the wire.

Ohm's Law.—The strength of the current passing through any part of a circuit varies di-

rectly as the difference of potential between the elements, and inversely as the resistance of the circuit itself.

The *milliamperemeter* is used to gauge the amount of the current passing through the patient. The sensation of the patient is, as a rule, not a guide to deep therapeutic action in the majority of cases. A current comfortable to the skin may become very uncomfortable over an eruption or abrasion underneath the electrode. The current passing into these spots at an uncomfortable rate causes pain and frequently electrolysis. Therefore, when a current of electricity



Rheostat.

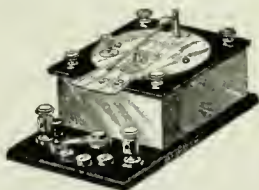
is being applied, these eruptions or abrasions should either be avoided or covered by means of collodion, adhesive plaster, rubber tissues or vaseline.

A *rheostat* is an instrument used to interpose resistance to the passage of current, and gives us a means whereby the current may be increased or decreased gradually, without the uncomfortable shock to the nerves unavoidable without its use.

In therapeutic work it should permit the gradual and gentle admission of a current after the electrodes are in place up to the strength and voltage required, maintaining it without fluc-

tuation, and, when work is done, permitting a gentle and gradual withdrawal of the current. A graphite rheostat is best for electro-therapeutic work.

For cautery work the rheostat must have a small resistance and a large current-carrying ca-



Rheotome.

capacity. It is usually composed of windings of German silver wire.

A *Rheotome* consists of a wheel, which rotates at a given speed, closing and opening the circuit at regular intervals, which may be varied as to length of time.



Portable Milliamperemeter and Rheostat.

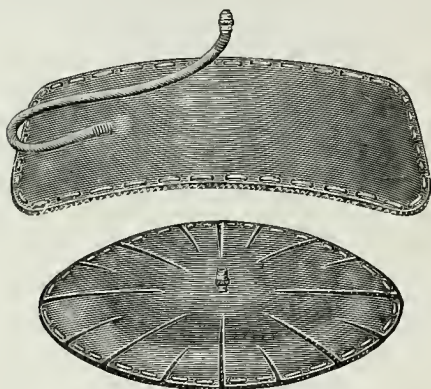
As a rule portable batteries have no meters, it is best to insert one in the circuit. a graphite rheostat may also be attached to control the current.

The materials used as *electrodes* must be good conductors of electricity, the heat conductivity

and electrical conductivity of substances being equal.

Water passes with difficulty through a pipe filled with sand, stones, etc., but very easily through large, clear pipe. Thus a wire of poor conducting material offers great resistance to passage of current, but a good conductor of large cross section offers little resistance.

With low pressure currents, such as the galvanic and faradic, it is essential that good con-



Abdominal Electrodes.

tact be made between any two parts of the circuit, for electricity has very slight power to jump through the air. Though the human body is composed of moist tissue it is surrounded by an insulating envelope of dry skin, which, together with the slight layer of air, offers a great deal of resistance to the current of electricity. Hence it is necessary that the electrode covering should be moist and thus render both itself and the cuticle better conductors. Deep penetration is the prime need for a well-moistened electrode covering. Moist absorbent cotton is easily ap-

plied and renewed. Well-moistened sculptors' clay may be used when a large abdominal pad is desired to transmit a large current with a small sensation and local resistance at this spot. If thoroughly adhesive and accurately in contact it possesses advantages over other materials.

A flexible cord composed of fine strands of wire is used as a conductor for the electricity, and as the strands making up this cord are frequently broken, they move apart, causing the current to reach the body in fits and jerks; hence they should be frequently examined as to their conductivity. Imperfect contact at the binding posts due to corrosion, also interferes with the conduction of the current.



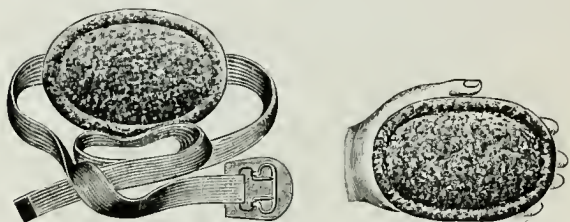
Carbon Electrode.

Electrodes must be made of substances not easily corroded by the current. Oxygen and chlorine set free in the vicinity of the positive pole attack the baser metals and form compounds with them. When it is desired to avoid this secondary action of the current, a carbon electrode may be used.

The carbon electrode is made to fit snugly against the insulated shaft, which is penetrated by a brass or copper rod. It is intended for use with the positive pole. Though it may be used with the negative pole, it softens the carbon and loosens the connection with the metallic rod. It is covered with a thick layer of cotton wrapped neatly and compactly about it. The carbon is first dipped in water and then by rotary motion

of the handle the cotton held in hand is twisted about the ball. It must be well moistened and soaped before use.

Gold, platinum and irido-platinum do not readily enter into composition with oxygen and chlorine. Therefore, steel instruments heavily plated will, for a time, serve the same purpose as those made entirely of the more expensive metal. Copper, electrodes of copper, zinc, etc., should be of as pure metal as possible and the surface brightly polished before each treatment. When we wish to use mercury, a copper or zinc



Sponge Electrodes.

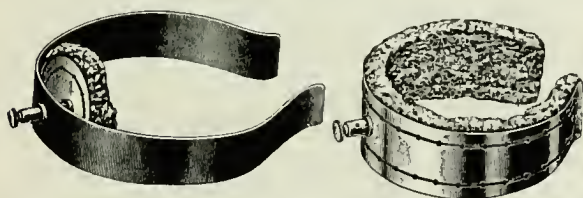
electrode is dipped into an amalgamating fluid and is ready for use after a little rubbing with a clean cloth to remove the excessive acid.

Thin sheets of tin or plates of malleable metal will be found serviceable in applying electricity to irregular contours, as joints, etc. When metals used for active electrodes corrode underneath the covering, the substance thus formed accumulates on the surface of the electrode and may irritate the skin, or may even be conveyed into the tissues and there produce undesired local medication.

The sponge electrode should be well moistened with a bicarbonate of soda solution, as it greatly increases the conducting power of all electrodes. Other salts used for this purpose are apt to irri-

tate the skin. The sponge electrode should be cleaned after each use. If a large area is to be treated soap the sponge well with a good shaving soap to permit its being moved about easily. The electrode should be moved about slowly to avoid sudden starts of muscle action.

Varying degrees of pressure applied to an electrode will cause a variation in dosage. Build up the dosage as tolerance increases. Over red-dened skin a current of small amprage will frequently bite, while on a pale skin it may not be felt at all. For electrolytic purposes the active electrode should be well insulated except where



Self-Retaining Electrodes.

action is wanted. A coating of shellac, or melted hard rubber may be molded about the electrode.

A large electrode is usually used as the dispersing electrode and is most conveniently placed on the sternum, the back of the neck, or even the palm of the hand. The resistance at the surface contact must be reduced as much as possible. The density of current must not be so strong as to cause electrolytic action on the tissues in contact.

The current is always greater in the polar than in the peripolar zone. The density of current varies directly as its strength and inversely as the area of its cross section. Thus beneath an electrode of two square inches the current density would be twice as great as beneath one hav-

ing four square inches, the current strength remaining the same.

The *polarity* of the direct current may be determined by means of moistened litmus paper, touched by the two cord tips a small distance apart. A blue discoloration takes place at the negative pole and a red at the positive pole. If the current is strong enough to decompose water, bubbles of hydrogen gas will gather at the negative pole, and, being in excess of the oxygen gathered at the positive pole will thus reveal the polarity. The positive pole is spoken of as the *anode*, while the negative is referred to as the *cathode*.

If a leash of needles is used and some of the needles are not doing their share of work let

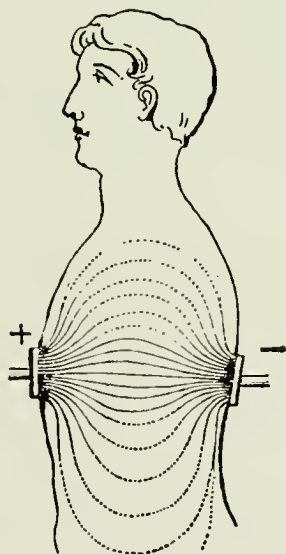


Needle Strand.

them remain in place for a time after the others are withdrawn, when their current will be concentrated along their paths and the desired action obtained. If it is found in electrolysis that the electrode cannot be readily disengaged, owing to the coagulation and drawing of the tissue about it, turn off the current and reverse the polarity and turn the current on again for a few seconds. The moistening effect of the negative pole will release the electrode so that it can be removed without difficulty.

At the conclusion of the treatment the negative needle is easily withdrawn, and it is found to be bright and untarnished. The positive needle, on the other hand, is withdrawn with difficulty, as it is adherent and it is more or less darkened and corroded according to the amount of current and time consumed in the treatment.

Current Diffusion.—The current does not travel through the body straight like a beam of light, but seems to curve somewhat about the poles. Especially is this the case in a large conductor like the human body, the circle rapidly increasing in size as we proceed from the pole. Hence it is difficult or almost impossible to bring



Current Diffusion.

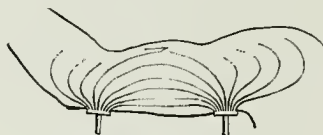
a concentrated current to bear on organs or growths that are beneath the surface. The nearest approach to concentration at a distance requires a heavy current at the pole contact. The effects are determined by three elements, strength, duration and concentration. The *cauterant* effects depend on the polar concentration. An electrode of a certain size with a determined number of milliamperes may not cauterize in

three minutes, but may in five. A half a milli-ampere applied at the point of a fine needle, as in the epilation of hair will cauterize in a few seconds.

It is in the immediate vicinity of the poles that the best therapeutic results are obtained, and the readiness with which electrodes may be brought in contact with diseased conditions is what the therapeutic effect depends upon.

PHYSIOLOGY OF DIRECT CURRENTS.

The direct current possesses chemical and physical-chemical properties of therapeutic value in the treatment of a great variety of morbid con-



Current Diffusion.

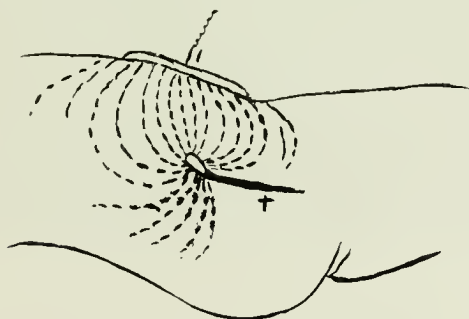
ditions. The action of the two poles is directly opposite and it is absolutely necessary to know which is which.

The *positive* pole attracts oxygen, acts as an acid caustic, is sedative in action, is a vasomotor constrictor, hardens the tissues and makes hard unyielding cicatrices.

The *negative* pole attracts hydrogen, acts as an alkaline caustic, is irritating and stimulating, is a vasomotor dilator, and liquifies and disintegrates tissues. Its cicatrices are soft and pliable.

The human body may be regarded as made up of tissue bathed in acids or alkaline solutions. By means of the direct current these fluids may be moved from one part of the body to another. If, for instance, the current be passed through a piece of muscle or beef the negative end will be-

come swollen from accumulation of fluids and solids, and the positive end will become dry and mummified, due to the accumulation of acids and the absence of liquids. Knowing the action of each pole, we place the electrode according to the action desired. For instance, we place the positive electrode over a painful and inflamed area to relieve the congestion by its vasomotor constrictor effect. The oxygen set free at this pole assists in oxidizing the tissue waste and toxins which clog the lymphatics, while the sedative action of this pole relieves the pain.



Current Diffusion in Pelvic Applications.

Absorption is stimulated, causing exudations, effusions and morbid fluids to be removed from the tissues.

On the other hand the negative electrode may be applied for its vasomotor dilator effects, thus causing a greater abundance of nutritive fluids to be brought to the tissues needing them, thereby quickening metabolism.

The current causes contraction of muscular tissue, both striped and unstriped, and invigorates the processes that depend upon muscular activity. Thus it restores the equilibrium of the circulation in the intestines and assists the excretory



Negative Electrolysis for Bed Sore.

organs, promoting elimination and overcoming passive congestion, and assists in relieving chronic cases of constipation.

By it we obtain definite knowledge concerning the action, nutrition and capacity of muscles and nerves, as by no other agent, and if the indications are chiefly those of degeneration, the negative electrode, by dilating the blood vessels with a current of ten to twenty milliamperes, improves their defective nutrition as no other agent at our command.

There is no feeling beyond that of heat under the negative electrode and a numb feeling under the positive. As the sensibilities of persons vary,

it is necessary to have an ampere meter to determine how much work is being done.

The interruptions in the galvanic current disperse the products of electrolytic decomposition and permit more vigorous interchange between the blood and the muscles, followed by increased nutrition.

Experiments have demonstrated that rhythmic galvanic currents produce improvement in nutrition where the continuous galvanic current has little or no effect. Experiments further show that a slowly interrupted galvanic current of about two milliamperes, each contraction being followed by a period of repose, produces the best effect. A rapid rate of change in the constant galvanic current is unpleasant, while a slow rate is a great comfort.

Thus all the effects of a powerful, intermittent faradic current are obtained. The dose must be modified to suit the ascertained reaction of each patient. There is an entirely different sensation imparted to the tissues, and there is no cramping of muscles as in the faradic, sinusoidal or Leyden jar current. It makes contractions and then lets go. Thus we often get response in paralysis from the interrupted galvanic when there is no response from the faradic. Don't exercise a muscle too fast or too long. You may be able to run at a certain speed for a certain distance, but you can't keep it up indefinitely. The continuous current of moderate strength applied gradually does not contract a muscle. If, however, there is a rapid change from maximum to zero and vice versa, it determines muscular contraction.

A given quantity of electricity passed in the form of a series of swift shocks, by a unidirectional current, may throw an animal into violent tetanus, exhaust the muscles and nerves, and

lead to gradual or sudden death, while the same quantity passed as a continuous current may leave scarcely any visible physiological effect.

By *electrolysis* we mean the decomposition of a compound body by means of electricity, as for instance, the decomposition of water into oxygen and hydrogen. (It must not be confounded with galvano-cautery which destroys tissues regardless of chemical composition.) In electrolysis there is no more heat than can be accounted for by the activity of the chemical processes.

The body to be decomposed must be a conductor of electricity and possess certain elements to be an electrolyte. So far as the human body is concerned it may be regarded as a six-tenths of one per cent solution of common salt (normal physiological saline solution).

When a current passes through a tissue it is conducted almost entirely by the inorganic constituents contained therein. Investigation has demonstrated that no current can pass through the human body without effecting electrolytic decomposition, or in other words, the only medium of conduction is chemical decomposition or electrolysis. It does not matter whether it is a continuous or alternating current. Electrolytic effects are produced not only in the medium immediately surrounding the poles or electrodes, but also in the intervening tract. (With the various forms of alternating currents, little, if any, accumulation of electrolytic materials takes place at the poles.) There has been decomposition, re-composition and redistribution. Conduction has been made possible by the conveyance of the charge from atom to atom in the intra-polar circuit. There is a movement of salts and fluids from the anode (positive pole), toward the cathode (negative pole), the free ions appearing at the poles. This action is easily observed in the

decomposition of water, which in its pure state is practically a non-conductor. Animal fat is a bad conductor. In living tissue the current is conducted by means of the blood vessels, the connective tissue and fluids. In dead tissue the resistance is enormously increased and practically acts as an insulator.

Under the microscope the tissues about the positive pole appear as though acted upon by acetic acid, the muscles and fibers are sharply defined and uninjured, no matter how great the change of the contents might be. When electrolysis alone is desired the electrodes must be composed of some material not acted on by the galvanic current, as platinum, gold or carbon.

The action of the current is best studied on a piece of beef. The glazed, dried appearance of the tissues about the positive pole is partly due to the cataphoric action of the current in driving liquids away from the vicinity of the positive pole, and partly to the action of the acids, muriatic, nitric, sulphuric and phosphoric, collected at the positive pole.

Around the negative pole the appearance is just the opposite. The moist and swollen tissue is surrounded by a frothy alkaline liquid. The alkalies here collected are soda, potash, lime and ammonium.

The positive pole affects the tissues as an acid caustic. It coagulates albumen and shrinks tissues, causing a superficial, dry, hard cicatrix. It stimulates absorption by contracting the blood vessels, and thus producing decreased nutrition. The contact of the positive pole with the mucous lining by a metal electrode is very painful and not easily borne. Oxidation of metal electrodes takes place at this pole, and deposits of metallic salt are made in the tissues.

The negative pole affects the tissue as an alkaline caustic, causing a deep red, moist, soft condition. Scars left are soft and retractile. Therefore when we have a dense, fibrous tissue to resolve or remove we use the negative pole. It is also used to avoid the white scar, usually following the application of the positive pole.

If the current is applied mildly it acts as a chemical absorbent and changes the histological structure of dense fibrous tissue, whether the result of inflammation or other pathological process. The details of the process by which this is brought about are still a matter of speculation. Probably the hydrogen gas forming in the tissues tends to expand the interstices of the connective tissues, which are abnormally dense and impenetrable, and that access of nutritive fluids is more freely established as well as conditions more favorable for absorption.

The desiccating action of the positive pole renders it of value in lessening congestion and checking hemorrhage, while the congesting effect of the negative pole renders assistance in impaired nutrition in dilating orifices or canals and in promoting flow of drainage.

Galvanic burns heal slowly. There is hot, burning pain at the needle. Dry resistance and friction mean heat. The parts should be saturated with an alkaline hot water, which will dilate the capillaries, and friction will be less and comfort more.

In certain joint diseases, ulcers, bed sores, etc., manifesting feeble reparative activity, the cause may have been primarily an injury, a bacterial infection or an inflammation of other origin, leaving obstruction from organized or unorganized exudates. The electric energy may be transformed into physiological energy and the reparative process is strengthened.

If inflammatory exudates or excess of connective tissue growth is the retarding cause aside from the devitalized state of the living cells, the action of the negative pole quickens the protoplasmic combination necessary for nutrition, aids in bringing more nutritive material and assists in the disintegration of the overgrowth of connective tissue elements (cathodal electrolysis). Thus bed sores, chronic ulcers, with horny-like margins, are soon changed into healthy surfaces, and granulating surfaces are aroused to quick repair by daily application of the negative current about their margins with a strength of about one milliamperes per square centimeter of electrode surface. As bacteria are usually in some defenseless or weakened area, thus tubercular joints may improve when treated daily for fifteen to twenty minutes.

The strength of current must fall short of an amount that would result in electrolysis of the mucous membrane or cuticle (less than fifteen to twenty milliamperes). Eight to fifteen minutes. Keep electrode gently moving over limited area during the application so that too great a density is not employed at one point.

Cathodal electrolysis is also used in the removal of non-vascular, dense, horny or warty moles and superfluous hair. A retrograde action, the reverse of tissue building, can usually be started in these abnormal or redundant deposits.

Anodal electrolysis.—Local derangement of blood vessels, such as naevi, cirroid aneurism, aneurism hemorrhoids, abnormal vascular growths of any kind, can have their blood supply cut off neatly and easily without resulting scar tissue. An abnormal growth may be arrested by robbing it of its blood supply by the destruction of blood and lymph vessels. Such growths, when treated, gradually shrink and are absorbed,

leaving the normal tissues in possession of the field, with an opportunity to repair damage with a minimum amount of cicatrical tissue. Moles and nævi must be treated with noncorrodible metals, such as gold or platinum, as the ordinary metal needle leaves a disfiguring metallic deposit in the skin. A great advantage lies in the fact that the electrolytic effect can be limited to destroy only the vitality of abnormal cells.

In the removal of fibroids needle or trocar-shaped electrodes are used, insulated, except at the part thrust into the growth, in order to protect the skin. Twenty to thirty millamperes are used for from three to five minutes.

A double needle electrode may be used, confining the current to the tissues between them.



Hemorrhoidal Needle Electrode.

The needles may be coated with an insulating coat of white varnish or vulcanite and thoroughly dried, the tip of the needle being protected from varnish by thrusting it into a cork.

The destruction of fibroid tissue at the end of the electrode results in a rapid absorption of the tumor. Care must be taken not to pierce normal tissue or to destroy more of the tumor at one sitting than can be absorbed. Fifty milliamperes may be used without too great density at any one point if a leash of needles is used for five minutes. This current is employed extensively in the treatment of goitres of fibroid nature, hypertrophy of the prostate, fibroid growths of mammæ, lymphatic glands, and fibromata of the uterus. It frequently causes a rapid diminution in the size of tumor or tissue. Infection is possible and

must be guarded against. Treatments may be given at intervals of from three to four days.

Electric belts or body batteries are capable under the direction of an intelligent physician of accomplishing a great deal of good in stimulating nutrition. Though the current is very small and of but a few milliamperes and few volts' pressure, it is capable of doing great harm unless employed with a correct knowledge of the physics of electricity and a clear conception of the disease to be combated. Polarity must be taken into account also the current strength and the time it would be safe to allow them to be used. Their use is very limited, but have been known to do a great deal of good in joint diseases and chronic ulcers.

By *cataphoresis* is meant the introduction of a medicament into the body by means of a galvanic current, the medicament traveling through the tissues beneath the skin with the current.

The pole selected for drug application will vary with its electrical affinity to the metal contained in the salt acted upon. Acids travel from negative to positive poles and vice versa. The large majority of drugs travel from the positive to the negative pole. Iodine is an exception to this rule. Potassium iodide, being very soluble, carries iodine into the tissues in a less caustic form than iodine alone, and goes in faster and in greater quantity.

Drugs containing alcohol, ether or chloroform, permeate the skin and mucous membrane readily by aid of the galvanic current. Cocaine, aconite, atropine and other drugs are thus employed.

Cocaine on the positive pole has a decided local anæsthetic effect, and will frequently relieve neuralgia when the current alone is without avail.

A fifteen to twenty per cent solution of cocaine in water may be used with a current of

from five to ten milliamperes for ten minutes. The negative pole may be held in the hand of patient. The skin must be thoroughly freed from its fats by means of soap, water and alcohol. It does not, however, produce anæsthesia enough for the performance of minor surgical operations.

Galvano-cocaine anæsthesia produced with eight per cent solution of cocaine in guaiacol is profound and facilitates minor surgical operations. One to three milliamperes will produce anæsthesia in four to five minutes, which may last thirty minutes. It may also be used in dentistry to deaden sensitive dentine. Guaiacol



Electrode for Drug Cataphoresis.

seems to localize the action of cocaine, preventing its dispersion through the body.

Salts diffused into the tissues do not produce tissue electrolysis, but remain in the tissues as a partly insoluble albumino-metallic salt, exercising by selective affinity, a denutritive absorbent action on diseased structures. The electrodes employed in electric diffusion of metallic salts are in the form of needles or bulbs.

The bulbs are used in treating diseased tissue, and the needles when it is necessary to penetrate diseased growths.

As the positive electrode is the one always employed in metallic diffusion, the electrode must always be kept moving to prevent adhesion and consequent damage to the mucous surface. If adhesion should accidentally occur reverse the po-

larity; this will release the electrode. Bulbs and needles should always be polished before using. Solutions of various metallic salts may be employed on the deeper tissues of nasal cavities, bladder and vagina, by means of special electrodes.

Electric diffusion of metallic salts from soluble electrodes may be instructively studied in experiments on hard boiled eggs or butchers' beef.

Mercury may be administered by amalgamating gold electrodes with this metal, i. e., causing the mercury to adhere to the electrode surface by first dipping the latter into weak acids and then into mercury. Employed as a positive pole the mercury disappears together with probably a minute quantity of gold and is diffused in the immediate vicinity of the electrode along the line of current flow, enabling us to saturate neoplasms and even cancerous tissue.

Intrauterine applications of metallic electrolysis may be made with any oxidizable electrodes, such as copper or zinc, which are the most popular at present, but electrodes made of silver, iron, lead or tin may also be used.

When a soluble metallic electrode is used there is no caustic action as is the case when non-attackable electrodes are employed, the current energy being expended on the electrode and in diffusing the newly formed salts into the tissues. When slight action only is required the electrode should be kept in motion and a low current strength employed (fifteen to twenty milliamperes). A caustic action is produced if the current is beyond thirty milliamperes, but this degree is rarely exceeded. The duration of the application varies from five to fifteen minutes. If the electrode becomes adherent it can usually be successfully detached by rotating it on its axis before attempting to withdraw it. If neces-

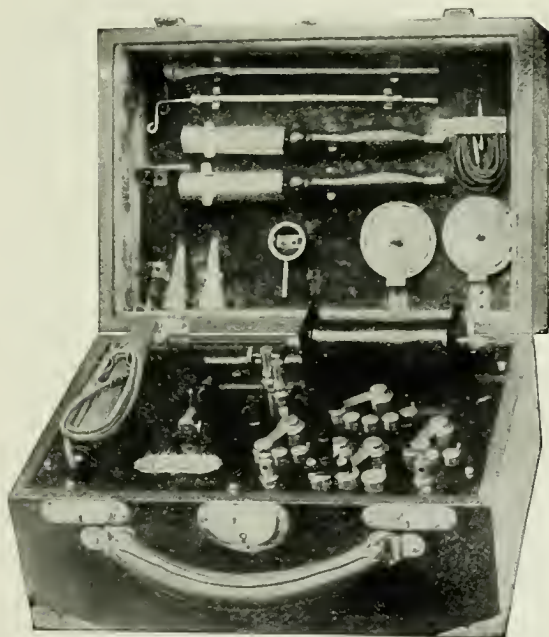
sary reduce current strength to zero and use negative polarity for four to five minutes, which will detach the adherent electrode.

Malignant tumors may at times be destroyed when placed under the cataphoric diffusion of the electrolytic salts of mercury or zinc. The radiating chemicals unite with the protoplasm of the cells and other elements of the growth, producing a rapidly enlarging area of necrosis, which is found to be more readily effective in the degenerating tissues. A current of from five hundred to eight hundred milliamperes applied from thirty to sixty minutes is usually necessary. At the termination of the application the growth has been changed into a lead-colored soft area, with a distinct edge, constituting the area of necrosis, surrounding which will be found a reddened, slightly swollen ring, constituting the zone of sterilization. Necrotic portions remain sterile and odorless until separation takes place, which usually occurs from seven to twenty-one days later, the wound healing by granulation.

Cancer germs are killed in situ, preventing the auto-infection of the cut edges that usually follows extirpation by means of the knife. The operation is bloodless.

Cataphoresis also permits the destruction of small growth or infected glands, etc. It permits localized destruction of growths within inaccessible cavities, such as the mouth, the rectum, etc. Being perfectly under control, it is capable of being directed at any point at will. When the disease is not too extensive it may possibly be eradicated. Failing in this it may be a great palliative.

In addition to electrolysis and cataphoresis, which are effects obtained only from the galvanic



Diagnostic Outfit.

current of considerable amperage, we have the distinct functional stimulation and sedation.

By virtue of the fact that stimulation and sedation occur only on the instant of variation of slight currents of high voltage it is confined principally to the galvanic and faradic currents. The functional stimulation produced is proportionate to the amount of variation and to the suddenness or the increased speed of variation. For speed of variation we might substitute pressure, for the greater the pressure the less milliamperage we require to produce stimulation. Nerve stimulation is thus limited to the opening and closing of the circuit when a weak current is used.

With a strong current the stimulation or sedation continues throughout the application, producing a contraction or sensation. All current variations are stimulant, though the continuous galvanic current is sedative at the positive pole, and very rapidly successive faradic currents of high voltage and minute amperage will act as an



Galvanic Stimulation.

analgesic. The action is always greatest when the concentrating electrode is over the nerve.

Tissues exposed to the negative pole of the galvanic current are distinctly increased in their excitability to stimulate. A positive pole has a contrary effect. The irritability of the parts is markedly decreased. The stimulating and sedative effects of the galvanic current are equally active on nerve and muscular tissue, and it is

probable that the glands and secretory organs respond to this current independently of their enervating and trophic nerves. The general tissue stimulating action of this current is demonstrated by the activity produced in tissue metabolism, nutritive repair and emphatic activity of the pelvic organs.



Galvanization of Pneumogastric Nerve.

When applying general galvanic stimulation the patient must be disrobed and lying on a couch. A large dispersing electrode should be placed over the back and connected with the positive pole. To the negative cord is attached a round, active pad, well moistened and soaped. The pad is held in contact with the patient and the current is turned on, after which the pad is passed over the nerve points of each group of

muscles, taking care to act only on the groups associated in action at one time. The current strength depends on the part of the body and the amount of adipose tissue covering the points. Fleishy persons require more current. Fifteen to twenty milliamperes will do for the arms, thirty to thirty-five on the legs and thigh and fifty and over for the abdomen and back. In weak and nervous people treatments are apt to be followed by a short period of vascular depression and cold extremities. But as strength is gained the warm reaction is more immediately realized.

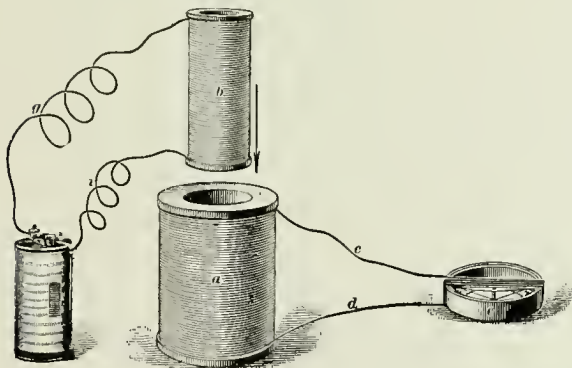
The galvanic current will be found preferable to faradic stimulation in the cases usually placed on the rest cure, the strong current transmitted through the abdominal viscera being particularly valuable in arousing dormant abdominal nervous forces so commonly deranged in these cases.

Delicate patients who have been treated for grave conditions of debility had better sit or lie down and rest for awhile after the treatment. A nervous chill sometimes follows over-electrization. The system can become habituated to electricity the same as it becomes accustomed to opium or any other potent remedy. Extremely sensitive patients nearly always bear a longer and much stronger application after a course of treatments. Patients need not necessarily be discouraged if short treatments with gentle currents only can be borne at the beginning.

When a headache persists for some time after a treatment, a mistake has been made somewhere in the application. Sudden shocks and interruptions may cause momentary headaches, which pass away after a short time.

THE FARADIC CURRENT.

The faradic current is produced in a closed wire circuit placed over or close to another in which a galvanic current is varied. The strength of the current so produced is proportionate to the strength of the producing current plus the length of the wire subjected to the influence of the inducing current circuit. Convenience necessitates

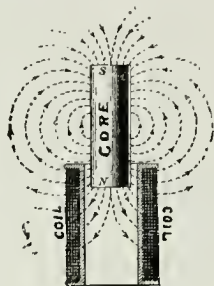


the coiling of one insulated wire about the other, producing a solenoid or induction coil in which many feet of wire occupy but a small space. It is necessary that the two wires carrying the inducing and the induced current should be close to each other and properly insulated.

The action of the inducing current from the cell in the first coil is increased if a soft iron

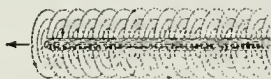
core be inserted within it, making what is called an electro-magnet.

Electro-magnetism is supposed to be electricity in rotation, and in every case the forces are exerted at right angles to each other. Certain metals under certain conditions exert an attractive or repulsive influence on each other. Science has



not been able to tell us what these forces are, but it has formulated laws under which these forces act and react.

The theory is that the ions in the space surrounding the conductor through which the direct current is flowing are influenced by the current, causing them to move about it in a certain di-



Magnetic Whirls.

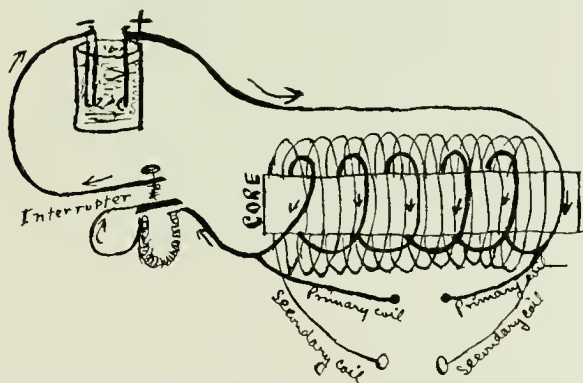
rection. These ions are very close together near the conductor, and farther apart as their distance from the conductor increases. A general idea may be had from this illustration.

Increasing the strength of the current increases the diameter of existing circles of whirling ions.

The cell current traverses the primary coil and returns to the cell through the interrupter.

While traversing this coil the current makes the core magnetic, which in turn attracts the small armature on the interrupter, breaking the cell current. The magnetism of the core having now disappeared, the spring returns to contact, when the whole process is repeated.

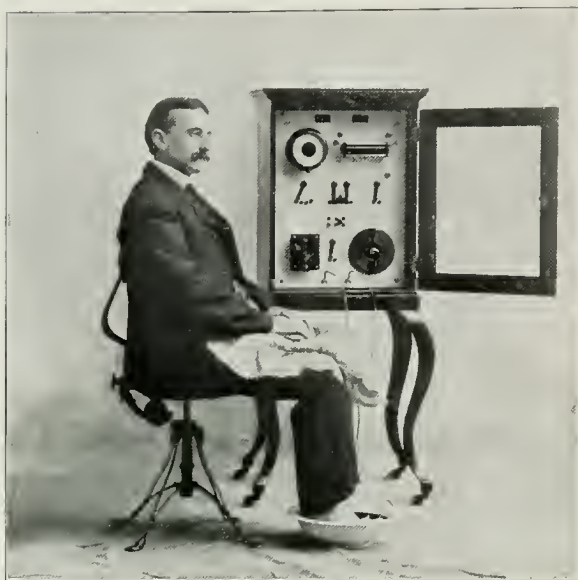
Induced currents are only caused by the changing strength of the magnetic field surrounding the secondary circuit. If a constant current is passing in the primary circuit there will be no induced currents, the strength of current de-



Faradic Apparatus, Showing Primary and Secondary Coil.

pending on the abruptness of change in the primary circuit, and their direction will depend upon whether the primary current increases or decreases.

The Vibrator.—There should be at least two adjustable vibrators, one for slow vibrations of fifty to one hundred and fifty periods per minute, giving muscles time to rest between each alternate contraction, but permitting adjustment of from two hundred to two thousand periods per minute for producing muscular massage; and one



General Faradization.

for sedation, with a rapid vibration adjustable for seven to nine thousand periods per minute.

The vibrator must be kept well polished and thoroughly free from oxidation, for starts and jerks in the vibratory movement are often unpleasant and sometimes harmful.

In the primary coil the patient is placed in what is called a shunt circuit, permitting only an infinitesimal amount of current to traverse the tissues when the spring is in contact, the resistance of the coil being many ohms less than that of the body of the patient. It will be seen that all the circuit takes the short road through the cell instead of through the patient. The current gets much of its force from the de-

magnetization of the coil. At the moment of closure of the cell current, a reverse does arise in the primary coil by self-induction, but never reaches the patient. When the cell current is open at the interrupter, however, the primary direct induction arising in the primary coil has no recourse but to traverse the patient. This induced current gets much of its force from the demagnetization of the core, and since it is produced in a coil nearer the core than the secondary wire, the volume of the current is greater, other factors remaining the same. The direct inductions only can reach the patient, the inverse inductions being neutralized by the cell current.

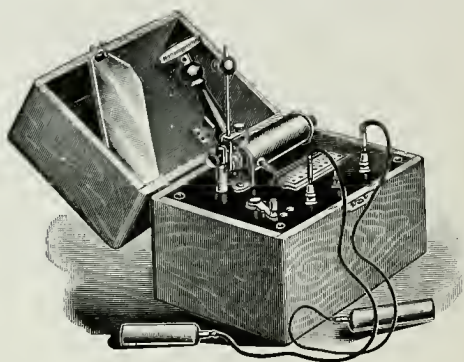
In a simple coil of but few turns a current arises, flowing in one direction in the second wire on closing the cell circuit in the first, and another current arises on opening the cell circuit. The current that appears in the secondary coil on opening the cell circuit is in the same direction as the cell current, while the current that appears in the secondary at the closing of the cell circuit is inversed, the current in the secondary coil being thus a to-and-fro current.

No amount of electrolysis can be caused on account of this continuously neutralizing character of an alternating current. It is this same condition that makes it impossible for us to measure the current strength. No current arises in the secondary coil unless its ends are closed by a patient or other conductor.

The large amperage of one or more galvanic cells is transformed into a current with a large electro-motive force and with a current strength of but a few milliamperes. What is lost in amperage is gained in voltage.

The voltage or penetrating power of the secondary coil depends upon the length and diameter of the wire used and on the number of wind-

ings. A coil with twenty windings possesses twenty times the electro-motive force of one winding. The fineness of wire reduces the volume of current. A coil of an equal number of windings of fine wire will have less amperage, and a heavy wire coil, other things being equal, will have a larger amperage. A coil wound with heavy wire acts on the muscles and not on the sensory nerves, hence is less painful. The fine wire acts on the sensory nerves and not on the



Faradic Battery.

muscles. When the secondary coil is only partly over the primary coil the resistance of the secondary coil remains the same, while its voltage is reduced.

Any unevenness in its action may be readily detected by connecting the various cells with a telephone receiver. The quality of the interruptions with slow and rapid vibrations may be studied.

The quantity of current is due to :

1. The galvanic current inducing the flow.
2. The primary coil.

3. The number of windings on the secondary coil.
4. Thickness of wire.
5. Interruptions.
6. Position of coil over the primary.
7. Surface resistance.
8. Kind and size of electrodes used.



General Faradization.

A number of secondary coils may be used. The secondary coils must be made of different lengths and sizes of wire, one coarse and one or more fine wire coils, if enough electro-motive force is to be developed for use in producing sensory and vascular sedation. Currents from very long wires are best in cases of semi-acute irritation, when rapidly successive inductions of high pressure

and extremely small volume only are bearable. As a condition of greater tolerance is established a more distinctly contractile current will give increased curative effects. Hence an instrument should have several interchangeable secondary coils from which to choose, the coil adapted to the case being slipped over the primary as required.

An apparatus now on the market consists of a set of three coils. Two switches on the end permit of tapping and using different lengths of wire from the same coil.

PHYSIOLOGY OF COIL CURRENTS.

The uses of the induction-coil currents are limited in their range of influence as compared with those of the direct current, their range being the physiological responsiveness of the tissues. Nevertheless, a large amount of valuable work can be done with a coil the frequency of whose interruptions can be varied at the will of the operator, and in which the electro-motive force in both the primary and secondary circuit may be conveniently modified.

The effects of coil currents are tonic and stimulating, or sedative and paralyzing, depending on the technique employed.

Slowly interrupted coil currents have little action on non-striated muscles, but when rapidly interrupted these muscles respond vigorously, each fiber contracting successively. The normal movements of the arteries and arterioles are stimulated, thus accelerating the flow of blood and lymph through the tissues and relieving venous stasis, absorption is promoted and elimination of waste material increased.

A coarse wire coil is to be preferred where there is a loss of tone and venous engorgement,

and it is contraindicated where the tissues are sensitive and inflamed. On account of the low voltage a large electrode should be used and the skin should be saturated thoroughly. Slowly interrupted currents of from thirty to fifty periods per minute produce a series of muscular contractions, with an intervening period and relaxation and rest. This physiological activity has a marked effect on the improvement of nutrition. Rapid interruptions produce tetanic contractions, which in turn bring about a muscular anæmia, and if prolonged will produce degeneration. Thus we see why a tetanizing current decreases neuromuscular nutrition. The coarse coil current lacks penetrating power on account of its low voltage, and, being limited to a smaller area, it has greater stimulating qualities.

The fine wire coil establishes local unconsciousness, allays pain and procures sedation. How this is accomplished is at present unknown. Its pain-relieving properties are, however, second only to those of opium.

The action of the alternating current on non-striated muscle fibers decreases rapidly in diseased conditions, such as paresis, atony, etc. It is a current of higher voltage, penetrates more deeply and is more diffused. Its action is spent on a larger tissue area.

The primary effect of the stimulating treatment may be a feeling of depression and lassitude, and soreness and fatigue may follow the first treatment. This can only be avoided by making the first treatment tentative and by using the hand as an electrode. In timid women and in the treatment of children it is best for the physician to use the moistened hand as an electrode until all fear is allayed, the hand being more agreeable to the patient, more flexible and adaptable, and has a lightness and softness of touch,

particularly for applications to the head and sides of the neck. It also keeps the operator informed of the current strength. He can increase or diminish the current by tightening or loosening his grasp upon the wet sponge.

The polarity of the faradic current is as distinct as that of the galvanic. The secondary



Applying General Faradization by Means of Hand.

also has a distinct polarity, though not so marked as the primary, the direct inductions being stronger and more abruptly produced than the inverse productions, the electrode on the negative pole being the most stimulating and the positive the most sedative.

It increases tissue metabolism, increases the absorption of oxygen and elimination of a corresponding amount of carbon dioxide. It there-

fore accelerates functional activity. This can be readily demonstrated by grasping a bi-polar electrode in the hand, and using a fine wire current as strong as can be borne for a few minutes. The hand becomes bathed in perspiration; it also becomes pale and bloodless, due to the tetanic contraction. Its power to promote rapid absorption



Applying Faradic Current by Means of Hand.

of inflammatory exudates may be attributed directly to its stimulation of the capillary and lymphatic circulation.

The increased contraction and the subsequent relaxation empty and fill the capillary vessels and, together, with increased blood pressure, favor the removal of any obstruction in them. By stimulating the contraction of adjacent muscles the veins are emptied, inviting the blood from the

overloaded capillaries. The lymphatic circulation is stimulated by the same process.

Muscular exhaustion is almost instantaneously relieved, and the lightness and buoyancy experienced in the muscles exercised are due to the increased supply of blood and oxygen to the muscle. Rapidly interrupted induced currents produce a



Anodal Electrolysis in Intercostal Neuralgia.

vibratory movement in the protoplasm of the body. We can appreciate the influence of this current when we realize that nine-tenths of the body is composed of protoplasm.

Faradization usually gives a refreshed and exhilarated feeling, usually following immediately upon treatment, and may last for hours. In others a fatigued and exhausted feeling may follow, with an intense desire for sleep. Patients suffer-

ing from nervous pains in the head, back, side, stomach and limbs frequently find relief during or shortly after treatment.

The disagreeable symptoms which sometimes follow general faradization, headache, malaise, vertigo, chilliness, faintness and cold perspiration, are not permanent, but are like similar effects from the injudicious use following other tonics. Extreme nervousness may cause unnecessary alarm.

The graphite rheostat used with the direct current is also used with the induction coil current, as the most sensitive patient will permit stronger current when applied gradually. By varying the pressure of the electrode held in the hand the current may also be increased or decreased. Great care must be exercised in applying the current over bony surfaces, as they are always painful. The treatment with the faradic current is less likely to aggravate the disease than the galvanic, as there are no chemical effects. It is mechanical and physiological in its nature, having no cataphoric or electrolytic action like the poles of the galvanic current.

A moist conductor conveys the faradic current through the skin to the nerves and muscles beneath, while the dry metallic is used in moist cavities only. The difference between the electromotive force between the galvanic and faradic current may be demonstrated by touching the bare terminals of each.

In paralysis the paretic neurons and impaired muscles may be improved in nutrition. Stimulation of the vasomotor nerves of the bowels increases peristalsis and accelerates the blood to the intestines, promotes secretion and relieves constipation. Glandular secretions are also stimulated.

When the intensity of the current has been arranged, the frequency of the interruptions must be considered. If the treatment is given with a view of stimulating the nutrition of weakened and impoverished muscles, they must not be made to contract with such frequency as to further exhaust them. Slow interruptions with complete and uniform contractions meet the need in such conditions. A rheotome, or a break-circuit handle, can be used to bring about these interruptions.

Short treatments are the rule. When there are a hundred or more interruptions per second there is a benumbing or anæsthetic effect produced on



Current-Interrupting Electrode Handle.

the nerve supplying the part. A rapidly and smoothly interrupted faradic current benumbs the nerves and abolishes pain. The rapidity of interruptions varies the quality of the physiological effect. From five to three hundred interruptions determine the muscular actions, while the sedative effects are produced by very rapid interruptions of twenty thousand to fifty thousand per minute. Muscle contractions cease with this rapidity. Slow interruptions favor muscle contractions; rapid interruptions affect the nerve. The anæsthetic effect increases with the number of windings, thinness of the wire and rapidity of the interruptions. A fine coil with thirty-five volts and thirty-five hundred interruptions a minute is frequently not felt after five minutes until moved up to fifty volts.

In bi-polar applications the effects from a short, heavy coil are stronger and of greater physiological effect than from a fine wire. As the resistance of the tissue increases fine coil indications improve. A current in a short wire gives a shorter spark with greater heat. A fine wire gives a long spark with less heat.

A powerful secondary induction coil made of two hundred and eighty miles of wire, with three hundred and forty thousand turns, yields a spark forty-two and one-half inches long when operated by thirty Grove cells.

Low surface resistance renders the current less painful and more penetrating without affecting the superficial sensory nerves, yet acting with



Faradic Brush Electrode.

energy upon the deep-seated muscles. Where we desire to stimulate the nerve terminals in the skin a dry electrode serves this purpose best, since the resistance due to lack of moisture intensifies the current at this point. The wire brush electrode is well adapted when counter-irritant effects are desired.

It is well known that any impression, mechanical, chemical, thermal or electrical, made on the terminal sensory nerves is carried to the central ganglion, where it is capable of modifying function or of even producing organic change. The difference between the sensation caused by the cathode, or negative, and the anode, or positive pole, depends on the size of the electrode. If the anode is small and cathode large, the current will be stronger under the anode, due to difference in current density. The current density

varies directly with the current strength and inversely as the surface area of the electrode.

It is absolutely necessary for the physician to have the therapeutic properties of the various currents firmly fixed in his mind. He must know how to regulate the electro-motive force and how to determine the number of interruptions necessary in a given case. The susceptibility of the patient and the varying tolerance of the different portions of the body will also require special study.

On account of the anatomical formation of the chest strong currents are not tolerated, yet currents of sufficient strength to increase physiological development are borne with comfort. There is no action produced on the heart and lungs, the application being merely a muscular stimulant. In some patients the splenic and hepatic regions are unaccountably tender and justify the suspicion that these organs may be more or less diseased. The current applied directly to the abdomen acts directly on all organs contained, regardless of nerve supply. Adipose tissue is a poor conductor and must be considered when treating corpulent persons.

On account of the physiological importance of the cilio-spinal centers, they should be given special attention in every general faradic treatment. The current is also used in treating spasmodic and hysteric contraction. Treatment must continue until the muscle is thoroughly relaxed, but repeated application may be necessary.

Nervous and active people respond to this current more readily than do the cold and phlegmatic. The nutrition of the entire nervous system is directly influenced by this current. In an ordinary application the brain, the spinal cord and the sympathetic ganglion are all subjected to the action of the current. The tonic effect of



General Faradization.

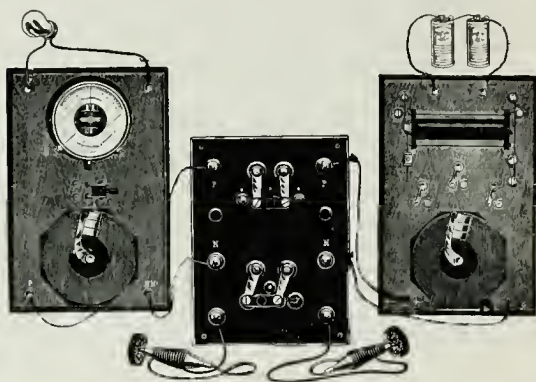
faradization is largely due to the passive exercise which it produces. It is both deep and superficial. The molecules are agitated just as the particles of a bar of iron are moved by the influence of magnetization. Every atom is kept in incessant disturbance.

A current too weak to cause muscular contraction is not followed by a marked tonic effect. The idea is to bring about not only a contraction, but a relaxation. The relaxation will in itself bring about an increased flow of blood to the parts.

Assimilation depends upon equalization of the circulation. The tissues of the body are frequently developed in size and firmness to a marked degree, and vigor is frequently imparted to those deficient in power by means of this current.

GALVANO-FARADIZATION.

Vigorous faradization alone produces fatigue. The use of the refreshing and invigorating galvanic current in conjunction with the faradic



Combined Galvanic and Faradic Currents.

enables us to obtain the therapeutic qualities of the first without the exhausting effects on the patient.

The effect is obtained by uniting the secondary induction coil and the galvanic battery in one circuit by connecting with a wire the negative pole of one and the positive pole of the other, attaching the electrodes to the two extreme poles and sending the currents through the body.

This current is especially indicated in diseases of the abdominal viscera and of the bowels.

Interrupted induction coil currents increase metabolism by action in the muscular system. Increased nutrition is produced in two ways, muscular contraction and stimulation of terminal sensory nerves, action on cell function and promoting gland activity.

Galvano-faradization is like adding two drugs to be administered in one prescription. Spasmodic conditions which have failed to respond to either of the other currents applied alone are relaxed almost immediately by galvano-faradic electricity.

ELECTRIC BATH.

The tub should be of wood or porcelain, otherwise the current will travel through the metal instead of through patient and the water. It must not be in metallic connection with the earth, and the waste pipe and water faucets should not be connected directly with the bath, but a rubber tubing used.

An ordinary bath tub may be used if a piece of rubber sheeting large enough to cover the inside of a bath tub be used.

With a current of moderate amperage and low electro-motive force, insulation is not necessary. If, however, we wish to make use of all the therapeutic properties of the electric bath, insulation becomes necessary, and is accomplished by placing the tub on insulating supports of glass or vulcanite.

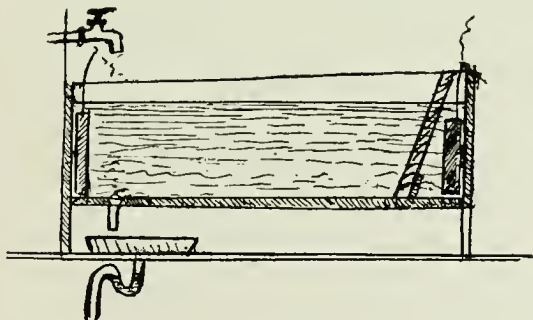
There are two kind of electric baths, namely: monopolar and dipolar.

Monopolar.—One electrode is placed to the nape of neck, arm or some other part of the body out of the water. The water bath constitutes the other electrode and very carefully adapts itself to all parts of the submerged body, the copper electrode in the water completing the circuit. If the positive current is used outside of the water, the current from this electrode will flow into the body, diffusing itself into the water from all parts of the patient, to be again concentrated at the negative electrode.

Only a moderate current can be employed outside of water, as a too concentrated one would

cause pain and produce destruction by local electrolytic action.

The *dipolar* bath is the one most used. The electrodes are usually made of copper, the larger electrode, twelve by eighteen inches, being used at the head, while the smaller electrode, nine by twelve inches in size, is placed at the foot end. The shoulders must not come in contact with the electrodes, as this would cause a burning pain. The soles of the feet, on account of poor conductivity, may be placed against the foot electrode.



Electric Bath.

The current may be continuous or alternating. The steady current may be obtained from the medical galvanic battery, but must be under control, hence the necessity for a good rheostat and milliamperemeter.

The patient should not be left alone in the bath, and pulse and respiration should be carefully counted during the administration.

It has been estimated that about twenty per cent of the entire current passes through the patient. Thus, if the milliamperc registers one hundred and fifty, the patient is subjected to a current of about twenty-five milliamperes.

The current should be turned on gradually, observing the effect on the patient. The temperature used is usually about $98\frac{1}{2}^{\circ}$ F., but it must be remembered that the higher the temperature the better its conducting capacity. When the physician can command any current strength desired, the temperature of the water makes little difference. The addition of salts to the water increases the conducting capacity of the water and lessens the current strength passing through the patient.

Various drugs dissolved in the water may be carried into the body by means of cataphoresis. Extracts of herbs and barks have been used with effect in a variety of troubles. According to an eminent European authority, tannic acid, which is much cheaper than the lithium salts, is very effective in the treatment of uric acid troubles.

Never give a bath to a patient immediately after he has had a full meal.

The effects of an electric bath are exhilarating, refreshing and invigorating to the patient. Circulation and nutrition are benefited and irritability relieved, and sleep is restored, and new vigor imparted to mental and physical faculties. The cutaneous glands are stimulated to increased elimination of effete material, and by increasing the amount of blood brought to the surface it relieves the congested internal organs.

For tonic effects the interrupted currents give the best results.

Gout, rheumatism, lumbago and sciatica have been successfully treated by the various currents. If the alternating current causes pain the direct current should be used.

In disordered circulation, as found in Raynaud's disease, the electric bath is the best known treatment. Weak currents are used to build up the nutrition of the parts diseased. The negative

pole is applied over the diseased area, the object being to increase circulation in the diseased member.

Chronic rheumatism, rheumatoid arthritis, gout and diabetes are diseases in which a judicious selection of currents and proper attention to detail in a course of electric baths will accomplish more than massage, medicament, change of climate, or all of them combined.

Neurasthenia frequently yields to electric baths when central galvanism and static electricity have failed.

Diphtheria and other forms of toxic neuritis are effectively treated, as it increases the activity of the organs of elimination.

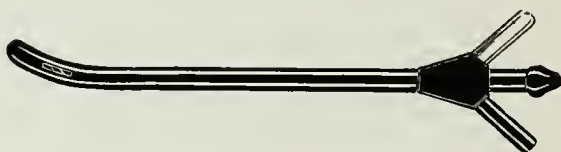
In giving an *electric douche*, the indifferent electrode is placed under the patient's feet, or under the gluteal region if the patient is seated. The water from the nozzle constitutes the other electrode. The water from the nozzle renders the skin a good conductor of electricity and at the same time increases the cutaneous irritability, rendering the action on the periphery stronger and more effective. Its conductivity is increased by raising the temperature of the water and also by the addition of salt or sodium bicarbonate. The nozzle must be held at some distance from the body and the flow of water must be delivered in an unbroken stream.

As the stream of water constitutes the active electrode, this form of treatment is adapted to a large number of pathological conditions, applied to mucous cavities and the mucous canal. In treating cavities electrified water may be used. The whole surface of the cavities may thus become more completely electrified than otherwise. The fluid must come in contact with the metal electrode within the nozzle.

Five to twenty milliamperes may be used, the

application lasting ten minutes. It may also be used in cases where the urethra is sensitive to the passage of a bougie or metal electrode. Electricity thus applied allays irritability, heals sore or bleeding points and prepares cases for electrolytic treatment. It reduces the inflammation which is frequently present and which prevents the introduction of instruments on account of the pain produced. It cures some maladies of the prostate and allays irritation, and cases of impotence have been reported cured in this manner.

Chronic urethritis is more safely treated by this method than by any other, because it dilates and puts the mucous lining on the stretch, thus



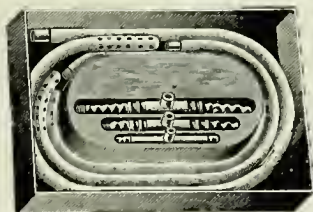
Urethral Electrode for Giving Electric Douche.

cleansing all the parts. The current is equally divided and better tolerated. By hanging the bag higher there is no doubt but that the posterior urethra is reached.

The dangers and difficulties of applying strong galvanic currents to mucous canals and cavities are obviated by the use of special electrodes, completely insulated and perforated to allow the passage through them of a current of water and electricity, the water in the canal constituting the true electrode.

A one per cent solution of common salt water may be used, though medicated solutions of copper, zinc or silver may be employed, the various salts being driven into the tissues by cataphoric action of the constant current. The inflamma-

tory infection of the uterine canal, ulcerations of the cervix, relaxed vaginal walls and weakened pelvic structures are thus conveniently treated by means of the vaginal electric douche. The temperature of the water must be regulated to suit the patient. In treating the bladder from



Hydro-Electric Rectal Tubes and Catheters.

twenty to thirty milliamperes may be used. Under this treatment, vesical atrophy or weakness is much benefited and good results have been obtained in inflammatory conditions.

By means of a special electrode a current of from twenty to thirty milliamperes can be employed within the rectum without danger of elec-



Rectal Hydro Electrode.

trolytic action. The water is allowed to flow until the rectum becomes filled, the water in the bowel constitutes the active electrode, and diffuses the current to all parts of the rectum and powerfully stimulates peristalsis. The alternating current will cause nonstriated muscle fibres to contract when not pathologically altered. Ex-

periments have proved that nonstriated muscle fibres when in parietic condition do not respond to coil currents, while vigorous contraction can be produced by the galvanic current. Inflammation and ulceration of rectal mucosa are frequently speedily cured by this means. Its use in chronic constipation should be familiar to all physicians.

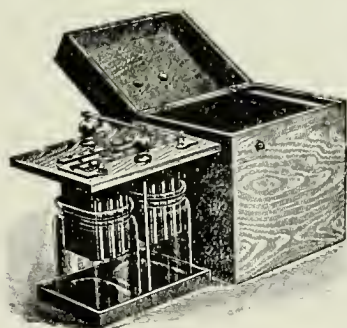
Catarrh of the nose and naso-pharynx are much relieved and frequently entirely cured by the electric douche.

In atrophic nasal catarrh, the diseased glands may be modified in their function and the function of the mucous membrane improved. In catarrh of the nose it may be found serviceable to add various medicaments to the water used. Among these cupric sulphate is perhaps the best. Atrophic cases of catarrh have been reported cured, with complete return of the sensation of smell. From three to ten milliamperes are used, the application lasting until three pints of water pass through.

GALVANO CAUTERY.

Energy cannot be lost. In disappearing it reappears in some other form. Whenever resistance is placed in the path of an electric current it can overcome the resistance only by giving up part of its energy, which reappears in the form of heat. It is this property which is used in the heating of lamps and cauteries.

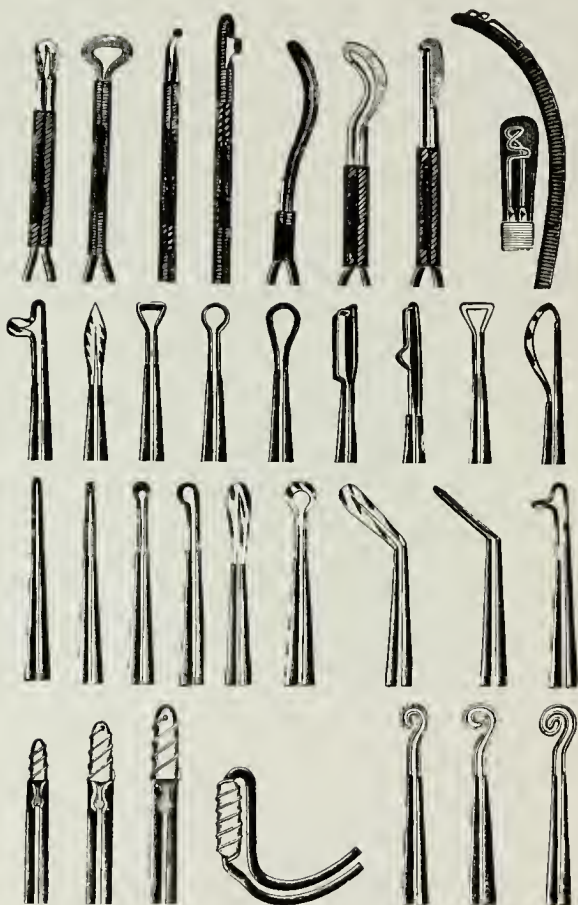
Either the commercial current, storage cells or



Galvanic Cautery Battery.

a battery with large zinc and carbon elements may be used.

Metals, fluids, etc., all show a difference in ability to receive heat from some source or other. Thus, a platinum wire held over a Bunsen burner will show a temperature three times higher than a copper wire under same length of exposure. Also, if a silver and platinum wire were held over the Bunsen burner together, the platinum would



Cautery Electrodes.

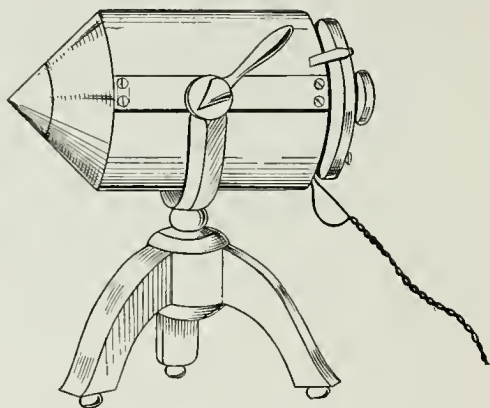
be red hot while the silver would be still comparatively cold. It is estimated that each molecule requires the same amount of heat to raise its temperature a certain number of degrees. Thus we see a clear relationship between thermal capacity and specific gravity. The greater the mass in weight of the conductor, the more time will it require to effect a rise in temperature. There is also some similarity between thermal and electrostatic capacity.

Electric-cautery has been extensively used and its recognition is well deserved. It has supplanted almost entirely the chemical agents formerly used, being completely under the control of the operator. The instrument may be carried without harm through a narrow or complicated passage until it reaches the desired point of action, and when the effect is complete it may be withdrawn equally harmlessly.

As a remedial measure, galvano-cautery is perhaps most frequently resorted to by the nose and throat specialist for the reduction of hypertrophic tissue, the cauterization of the seat of the implanted mucous polypi, ignipuncture of the tonsils, etc.

MAGNET.

The use of a magnet has become the principal means of extracting foreign metallic bodies from the eyeball. A small magnet may be used where the foreign body is imbedded in the superficial portions of the eye. When imbedded in the



Giant Eye Magnet.

deeper portions of the eye, a giant magnet, regulated by a rheostat, will frequently avoid an otherwise delicate operation. In fact, may prevent enucleation in many cases. In opacities of the eyeball, it is no doubt a great aid in making a diagnosis as to whether metal is present in the eye or not.

The magnet has also been successfully used in the removal of a pin from a child's larynx or bronchus.

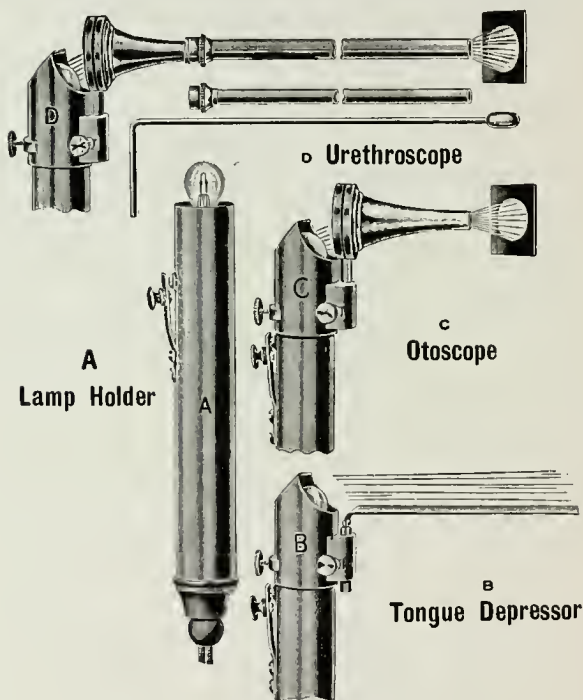


Small Eye Magnet.

Electricity also plays an important role in a variety of mechanical appliances, such as electric drill motors, mechanical nasal saws and vibratory massage operators.

ILLUMINATION.

The electric light is used more generally than any other illuminating agent in the examination of the nose, throat, ear and bladder. The incan-



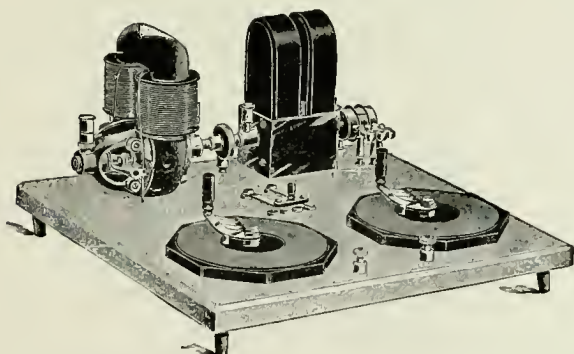
Illuminating Instruments.

descent lamp has its special advantage in this purpose, of which these illustrations give ample evidence.

SINUSOIDAL CURRENT.

The sinusoidal current is an alternating current generated by induction in a coil of wire which is rapidly revolved in the magnetic field of another coil and core.

This current can be secured from any apparatus having a permanent magnet or any coil having a temporary magnet. The rapidity of the

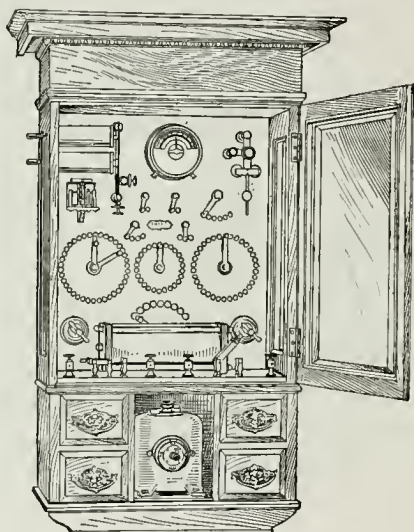


Apparatus for Generating Sinusoidal Current.

revolutions of the armature determine the character of the sinusoidal current. It is best generated by an apparatus turned by an electric motor in order to get the greatest speed and the most regular curves or waves.

In an armature or coil which is revolving in a circle and making a revolution back to the starting point, always in the same direction and not

stopping to swing back as the pendulum vibrator does, there is consequently no dead point, and the make and break is not felt painfully or with any shock. This produces a harmonic or sinuous wave-like contraction and a soothing or pleasant sensation, relieving pain and often producing anaesthesia, by causing temporary paralysis or tetanization of the nerves.



Wall Plate for Galvanic, Faradic and Sinusoidal Currents.

The physiological effects produced by the sinusoidal currents are painless and have great penetrating power. The constant alternation of the current prevents polarization of the tissues acted upon, and hence maintains the maximum exciting effect. Various effects are noticed according to whether the machine is rotated at a high or low rate of speed. When rotated slowly

the contractions are vigorous and spasmodic, rather than tetanic in character.

Strong muscular contractions may be induced without the slightest sensation to the skin and without any pain whatever. With rapid rotation of the machine the current is capable of producing strong tetanic contractions similar to those of the faradic machine.

STATIC ELECTRICITY.

Static Electricity.—The ethereal theory presupposes that electricity in a neutral or mixed condition is present everywhere, pervading all space, penetrating between molecules, etc. When two dissimilar substances are placed in contact, one of them always assumes the positive and the other the negative charge. It was formerly thought that only a limited number of bodies could produce an electric charge when brought in contact with each other, but later investigation shows that friction between any two bodies of different substances will produce an electric charge.

The amount of electric charge or energy stored up, in either of these bodies, is not in proportion to the work done by friction, but only in the small work done in separating the bodies against their mutual attraction, which depends upon whether they are good conductors or not. If a charge is communicated to one end of a glass rod, it will remain there, and not pass to the other end, as it is a poor conductor. Metal is a good conductor and offers no resistance to the rapid distribution of the charge.

From the foregoing statements it is seen that negative and positive electricity are not generated, but merely moved from one body to another. It is impossible to bring forth one charge without bringing forth the other. There is a difference of potential between parts of the same body or between different bodies. The medium between the two forms of electricity is in a state of strain, as they are eagerly seeking to unite

with each other and again produce a neutral condition.

Friction is not the cause of electricity, as is heat, but friction dries and warms the surface, which favors insulation, and thus prevents the escape of electricity. Whether the bodies be brought in contact by either rubbing or sliding friction, seems to be immaterial. The main thing seems to be to bring the various parts of the surface of one body successively in contact with the surface of a dissimilar body, and separate them in order to produce a charge.

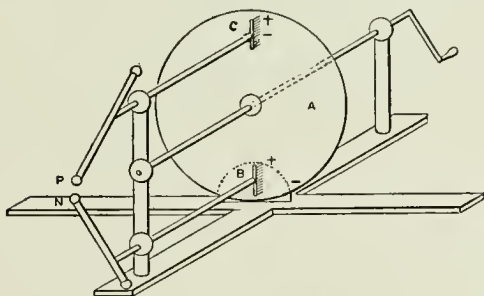


Diagram of Static Machine.

To understand the workings of a static or influence machine, as used in therapeutic work, it is necessary to bear in mind that when an electrified body is placed in the vicinity of other bodies, insulated or not, it sets up in these other bodies electrical modifications; that is, variations in the distribution of electricity, acting upon them by influence. While acting on others, however, it is also acted upon. Its repartition of electricity is being altered. Electrical bodies with similar charges are mutually repellant, while electrical bodies with dissimilar charges are mutually attracted. The process of generating a static cur-

rent is best described by means of the following illustration.

The initial charge of electricity is developed by friction; by induction on the plate the comb B will become positive and the knob at the end of the prime conductor will become negative. The comb, however, readily gives up its positive charge to the plate, so that the prime conductor BN is left negatively charged.

When the plate has made half a revolution that part that has been charged positively, from the comb B arrives at comb C. Thus the two combs will always be at a different potential, and a steady flow of sparks will ensue between the ends of the prime conductors P and N. The electric charge passes from the plate to the positive comb and from the negative comb to the plate. When the machine is operated in a dark room the difference in the discharge from and to the different combs may be noticed, the purplish flame occurring on the negative side.

Induction can take place through some distance, and through materials such as air, glass, etc. When the electrically charged body is removed it will again return to its neutral condition, the inducing body having lost none of its charge. The smaller the distance between the two bodies the stronger the induced charge.

As some bodies permit induction with greater facility, the substance residing between the two charges is of importance. Dry air offers more resistance to induction than any other substance. Electricity cannot flow through glass, yet it is able to act across it by induction. This fact is utilized when it is desired to have a high potential difference between the two charges.

According to the principles already explained, the Leyden jar is found to be a convenient condenser of electrical charges. One charge by at-

tracting the other will not allow it to become free, but will keep it fixed and free from tension. The capacity of the two charges are correspondingly enlarged, but will, of course, possess the opposite potential.

The Leyden jar is made of glass, coated inside and out with tin foil, which serves to distribute the charge over the surface of the glass. A brass rod, passed through a lid of dry, well-varnished wood, is connected with the inner coating by means of a brass chain.

To charge the Leyden jars, connect them to the prime conductor of the static machine and connect the outer tin foil with the earth. The positive charge on the inner coating induces a negative charge on the outer coating nearest the glass, repelling the positive charge, which passes to the earth.

To prevent the charges on the prime conductor from uniting, a spark gap is placed between them. This causes the charge to flow into the jars on the inner coating and induce an opposite polarity on the outer coating. These charges continue to flow into the jars, where they are held by induced charges on the outside of the jar. Both are bound, but cannot unite and neutralize each other. When the difference of the potential between the charges of the two jars has reached such a value that it is able to overcome the resistance of the air gap, it will bridge it by means of a spark. When this has taken place, the inside charges have neutralized each other and the outside charges are free to unite. The current is of an oscillating character.

The discharge between the poles of the prime conductor tends to neutralize the electric charges on the latter, but the self-induction of the circuit causes an excess of current to rush to the respective poles, charging them the opposite of

what they were, this condition being again neutralized by a spark, etc. The frequency of oscillations will depend principally on the volume of current supplied to the jars, on self-induction, the air gap and the resistance in the circuit between the jars.

PHYSIOLOGY OF STATIC ELECTRICITY.

We have in static electricity the remedy par excellence for treating the patient as a whole or locally, and there is probably no one agent at the physician's command by which so much good can be accomplished as by a skillfully handled static machine.

The more intimately the physician becomes acquainted with the nature of static electricity and the physical laws, which govern it, the more readily will he comprehend its application.

Static electricity as generated by the modern machine is a current of extremely high voltage and a very low volume. It is by reason of this low volume that the current may be passed through the tissues of the body without inflicting injury and with only a moment's discomfiture. It is probably the most powerful stimulus to nerve and muscle that can safely be applied, to say nothing of the rapidity at which it imparts tonicity, lightness, buoyancy and firmness to soft, lax and enfeebled muscular tissues.

The physician well acquainted with his static machine soon finds that there are few physical ailments, except those of a surgical nature, which cannot be greatly relieved by one or another of the static modes of treatment intelligently applied.

In studying its action or in applying it in practice, we must remember that the principles underlying the use of static electricity are the same as

those which govern the use of drugs, and that individual observation and experience must teach us what to expect. If static electricity would do in every case what it has done in some cases, it would indeed be a panacea or cure-all; but it is, nevertheless, a fact that its proportion of failures is not greater than that of drugs deemed most reliable in their action.

Electricity in any form is now recognized as a mode of molecular motion akin to light and heat. Every application of electricity to the human body, whether general or local, is accompanied by transformation of electrical energy into some other form of energy, either physical or chemical.

Investigation and chemical analysis have demonstrated that static electricity increases metabolism by mechanical as well as chemical processes. Static electricity causes a contraction of protoplasm, thus causing a mechanical disturbance of the molecular arrangement, which results in a modification and augmentation of metabolism and a modification of the processes of nutrition.

Static electricity regulates the various forces of the body by re-establishing the disturbed equilibrium in the different organic functions; it accomplishes this by its action on nerve fibers, cells and centers.

The statement is frequently made that "the relief brought on by static electricity is only temporary and not a cure." This is certainly due to a want of thoroughness and appreciation of the physiological effect taking place. It is a fact that what can be accomplished momentarily can by repetition be made permanent.

The physical culturist tells us that to exercise a limb will give strength. On the face of this it seems ridiculous, for by every physical effort the much needed energy is dissipated. Nature, how-

ever, over night, not only replenishes what was lost, but adds a little more to it each day; so that an exercise which seems difficult to-day will become easier on each successive day, indeed become almost an unconscious effort. It is in some such way that static electricity affects the nerves.



Weakening Current, Operator's Foot on Platform.

A nerve, being capable of vibrating at its own normal rate temporarily, can, by repeated efforts on our part, be made to assume its own rate of vibration permanently.

Static electricity does not replace destroyed tissue, but by its action induces muscular contractions, causing an onward flow of the blood stream. These contractions include the muscular

coats of the vascular system. This increased circulatory activity, by carrying onward the various internal secretions, stimulates the internal glandular organs to an increased functional activity, assisting not only the secretory organs, but converting by-products into end-products by the in-



Static Insulation.

creased oxidation, and eliminating toxic matter through the skin, kidneys and lungs, thus clearing the path for nature and allowing her to do her work more perfectly. With this increased excretion and elimination of waste, nervous irritability is lessened and is soon followed by a relaxation of the entire nervous system. Casts and albumen frequently disappear from the urine.

"Pain is the cry of a nerve for better blood." One of the cardinal dogmas of biology is that the structure of every living being is passing through a continuous transformation during its whole term of existence. That these transformations may be of a healthy nature, it is necessary that there be a continuous flow of nutritive fluid. A



Negative Spray in Pleurisy or Intercostal Neuralgia.

temporary disturbance in the blood stream brings about a diseased condition, and it is absolutely necessary to remove this condition of stasis, before a healthy, normal condition can be restored. Static electricity, by causing muscular contraction of the vascular system, is best calculated to relieve, temporarily at least, the congestion and hyperæmia; pressure being thus removed, pain is

diminished and a healthy metabolism is induced, thus checking and modifying the course of the disease, and even rendering patients suffering from incurable diseases fairly comfortable.

During the period of convalescence from any disease, the body is practically below par and



Posture in Treating Neuralgia of Shoulder.

therefore in a condition to become the seat of morbid processes. During this period of vulnerability inherited predispositions are apt to manifest themselves. Though static electricity has no effect on germ life, it removes this lowered condition of vitality essential for germ growth; by inducing functional activities it assists in the absorption, and enhances the assimilation of what-

ever medicament has been administered. This is especially true in constitutional diseases, such as syphilis, Bright's disease, diabetes, etc., where it not only aids absorption but hastens elimination as well.

The author believes static electrification to be far superior to oxygen inhalations in uremic poisoning. He has repeatedly taken a patient delirious with uremic poisoning and placed him on an insulated couch and has seen him regain consciousness in from ten to twenty minutes, according to the severity of the intoxication.

In cases of diabetes and nephritis the author has had results with the use of static electricity and drugs which utterly failed to respond to drug medication alone.

A man or woman subjected to a severe mental or physical strain may avert the final breakdown by a few properly applied static treatments.

Infants one and two years old suffering from gastric troubles and malnutrition have yielded to static treatments after well-known specialists had failed to bring aid by means of drugs and carefully chosen diet.

School girls at the age of puberty may be supported and carried through this trying period with entire satisfaction; the woman who is passing through the menopause, accompanied by all its nervous phenomena (with no definite pathological basis), may be soothed and comforted, and have her perverted nervous functions restored to their normal course.

Old people in whom the powers of life are waning brighten up wonderfully, both mentally and physically, after a few treatments.

Coincident with this increased activity we have increased appetite, restored digestion, renewed strength and vigor, creating a feeling of refreshment.

A person who has not witnessed the great amelioration of pain in lumbago, intercostal neuralgia or rheumatism can form no adequate conception of its merits.

Theoretically, static electricity may be employed in some stage of every disease, but finds its ideal sphere in such conditions as the following:

Malnutrition; Anemia; Neurasthenia—Nervous Exhaustion; Hysteria; Muscular Pain; Rheumatism; Neuralgia; Lumbago; Sciatica; Coccygodynia; Headache; Paralysis; Chronic Synovitis; Reflex Pain; Pre-bacillary Stage of Tuberculosis.

ESSENTIALS.

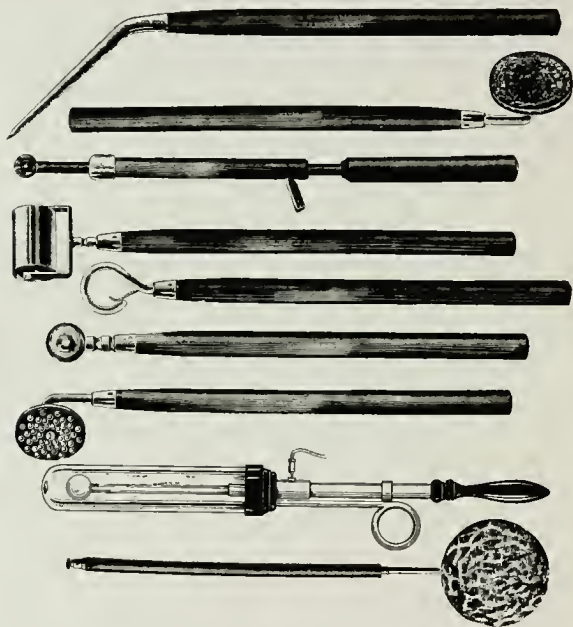
To be successful in the use of static electricity it is absolutely necessary to know the machine and how to keep it in working order. The usefulness of the machine itself will be what the operator makes it and no more. Brilliant results can be anticipated only from the combination of an effective machine and a skillful operator.

As atmospheric changes affect the nature of static discharges, the machine should be placed in a dry room, and should be evenly and solidly fixed to give steady and regular motion.

The loss by leakage through accumulation of dust and moisture upon the surfaces of the insulated parts frequently interferes very markedly with the efficiency of the machine, as the electricity is conducted away as fast as it is excited. After a machine has been cleaned, it can be dried out perfectly in a few minutes by the use of a freezing mixture.

Take a glass fruit jar that holds several quarts, and which may be tightly sealed. Fill this jar with a mixture of about one-half cracked ice and one-half salt. Then seal, wipe thor-

oughly and set inside of the machine on a plate, so that the condensed moisture on the outside of the jar may be caught by the dish. Then close the case tightly. If it is desired to dry the case quickly, run the machine slowly to set the air in circulation. A deposit of ice or frost will



Electrodes for Applying Static Electricity.

form rapidly on the outside of the jar. Permit the jar to remain in the case until the coating of ice becomes quite thick. Then take it out of the case and remove the coating of ice. Replace in the case and allow a second coating to accumulate. Never allow the jar to remain after the coating on the outside of the jar does not freeze.

If moisture does not collect on the jar, it shows the machine is dry, and if the machine refuses to work, it is a positive proof that something besides moisture is interfering with its operation.

Several pounds of thoroughly baked calcium chloride, placed on trays within the case of the machine, with doors tightly secured, will absorb the moisture as it enters the case. The condition of the chloride will indicate the necessity of rebaking it (which should be done in a slow oven. It must not be boiled).

Ordinary calcium oxide (quicklime) may also be used with very satisfactory results. In a box made of strips of wood, with large opening all the way round, place about ten pounds of calcium oxide, and cover it well with several thicknesses of muslin to prevent the dust from getting on the plates of the machine.

A hygrometer will be found of value in determining the condition of the machine from month to month, for under the same relative atmospheric conditions the discharge from a machine is uniform, or the machine is not in a normal condition.

Keep the machine well oiled.

Ground the poles, connect with gas, water or steam supply pipe, or drive two iron pipes into the ground until they reach moisture. Two groundings are necessary. Bring the copper wire to within short distance of the machine along the wall and bend to terminate in a hook. Bring the other grounding for the electrode near the machine in the same way. Grounding the machine is the most important rudimentary principle in using static electricity. Always ground the electrode and prime conductor not in use.

The object in grounding is to create the lowest possible pressure at this pole, while the



Grounding the Static Machine by Wire Attached to Upper Part of Case, Which Can Easily be Transferred to Opposite Pole.

highest pressure is maintained at the other. Without this difference we cannot get a current of high voltage.

The platform is an essential part of the static treatment by insulation and in the application of the wave current, etc., or there would be no accumulation.

Place the platform about two feet from the machine. The current is led to the machine either by means of a shepherd's crook or an insulated cord. These may be connected by a chain with the copper plate, 15 by 16 inches, under the feet of the patient, or by placing a metal conductor in the hands of the patient.

If the patient is too near the negative prime conductor, when the platform is connected with the positive pole and a strong current of high resistance is present, it may prove disagreeable to the patient. Place the patient so that the active prime conductor is opposite the head. This avoids irritation of the patient from woolen clothing with an opposite breeze.

The patient, if a female, should remove hat pins, and should not use metal or celluloid hair pins. Metal may cause unpleasant sensations and annoy timid patients, and celluloid pins have been known to ignite from a strong spray or brush discharge.

The current has no effect on a watch.

The chair on the platform should be devoid of all metals, nails or ornaments, as they may prove very irritating and annoying to the patient.

In moving about platform the operator should keep out of sparking distance of the patient, as an unexpected spark may greatly lessen confidence of patient, or cause him to cease treatment, as many have found out to their regret.

When the current is interrupted by sparks in any part of the circuit, the brass plate under the feet may become disagreeable to a patient who wears shoes with thick soles or iron pegs in the soles. To avoid this the conductor may be held in the hands of the patient.

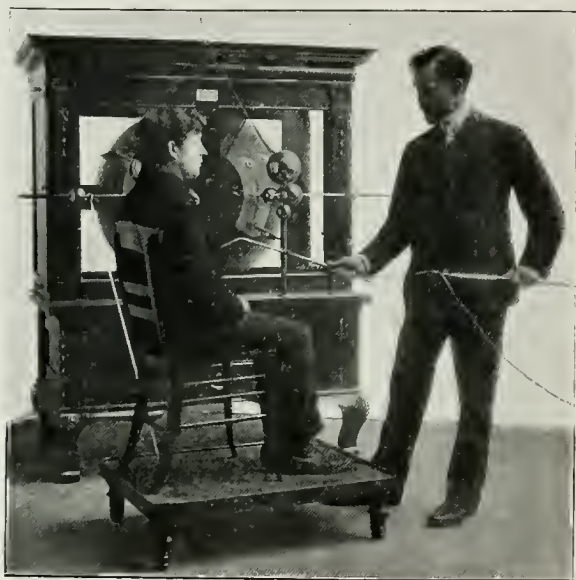
If for any reason the machine is stopped during the administration of treatment and again started or the speed accelerated, the passage of a single or infrequent long sparks at the spark gap may produce unpleasant sensations of shock.

If the noise of the discharging rod annoys the patient, make use of the muffler.

As the polarity of the machine may change from side to side while at rest or in taking a new charge without apparent cause, it is necessary

to have some manner of determining which is which. With sliding poles about an inch apart, start the machine slowly and observe the pole from which it passes. This is the positive pole.

With a spark stream about five inches long, ground one electrode. If it is the positive pole the current will be conducted to the earth and



Movable Spray Over Solar Plexus for Nausea.

the spark-stream will stop; if the negative pole is grounded, the stream will continue.

In a dark room, polarity may be determined by looking at the plates. Only a few stars are found on the metal comb on the positive side, while a heavy ultra-violet stream will be seen on the negative side.

When a machine changes polarity while in operation, there is a loss of charge by leakage.

Polish the metal surface of the electrodes and ball on sliding rods, so that the current glides off as smoothly as though lubricated. A chamois-skin is essential in keeping the electrode in good condition. Every irregularity interferes with a full flow of the current.

Every static machine will require renovation according to the amount of work done and care taken of it.

After thoroughly cleaning and drying the plates it will be well to cover the revolving plates with a coating of the best varnish.

The metal parts inside the case should also be lacquered. This is a difficult thing to do without taking the machine apart. When properly cleaned the machine is as good as a new one.

In static treatments we do not make contact with two poles, for if we do, then we either destroy the essential accumulation if the patient is on the platform, or we must use a Leyden jar current, which is the same as the faradic, and, like it, it has no electrolytic or osmotic action. On the contrary, charged with but one pole, the pull is not inward but outward to the grounded pole, on account of the attraction by opposite electricity.

To be a successful operator, it is necessary to know the sensation produced by the various modes of treatment, and how to differentiate between a tonic, a sedative and a counterirritant or rubefacient effect. Rudimentary skill in static application is quickly acquired through self-treatment, but skill can be acquired only by carefully studying the action of the current on different tissues and the varying resistance offered by different fabrics. Discriminate dose regulation by practice on yourself. The static current

is not limited to one method of application, and, as in drugs, the therapeutic results may be obtained in more ways than one.

The action of local static applications exerts a powerful influence far beyond the area on which it falls. The surface stimulation of



Treating Sprained Thumb by Wave Current.

sensory nerves, as has been demonstrated, is transported to central ganglia, where it produces lasting effects.

You must be able to vary the speed of your machine or you cannot vary your dose regulation, which you must, as you would a dose of morphine or strychnine.

INSULATION.

Seat the patient on the platform and connect the positive prime conductor with the platform by means of a conducting rod or cord, and connect the patient's feet with the conductor by means of the chain and foot plate or by holding the conductor in the hand. Ground the negative pole. After the plates have been set in motion separate the poles as widely as possible.

Positive Insulation.—The current of electricity, being a mode of motion, is conducted through the air in contact with the skin, and disassociates its molecular structures, upon the same principle as if a drop of oil were placed in a glass of water and stirred rapidly enough to break it up in minute particles. The more rapidly it is stirred, the finer the decomposition or disassociation of the structure. The large quantity of free oxygen or ozone thus developed is rapidly absorbed by the tissues. In consequence of this it has a wide range of usefulness as a tonic, especially in tuberculosis. We can appreciate this when we consider that all the various chemical activities occurring in the body are combinations of oxygen with food supply.

Positive electrification is more energetic than negative, on account of its higher voltage, and is correspondingly more valuable as a therapeutic agent.

With positive insulation the negative breeze often proves very irritating, and may be moderated by diminishing the resistance, removing heavy woolen clothing, etc. It is not irritating through cotton material or on the bare skin.

Negative Insulation has no advantages over positive insulation, with the exception that the negative breeze is seldom irritating from without, and sparking seldom occurs, and for this



Static Insulation.

reason it may be used with nervous and easily excited patients.

Patients enfeebled by recent illness, cases of anemia, neurasthenia and patients extremely susceptible to the weather on account of their debilitated condition frequently improve very rapidly under this treatment. When a person is "run down, overworked and fagged out completely," but is unable to leave business and seek rest, this form of treatment is of undoubted benefit, as it takes a great load off the already overworked organs. The effect is less marked as we approach the normal state. It is applicable to any age, from the infant to the extreme limit of old age.

In cases of extreme nervousness and apprehension, no attempt should be made to do more than have the patient sit upon the platform in a condition of charge. This is especially true if a marked hysterical element enters into the case. inflammations, eruptions and burns.

BREEZE.

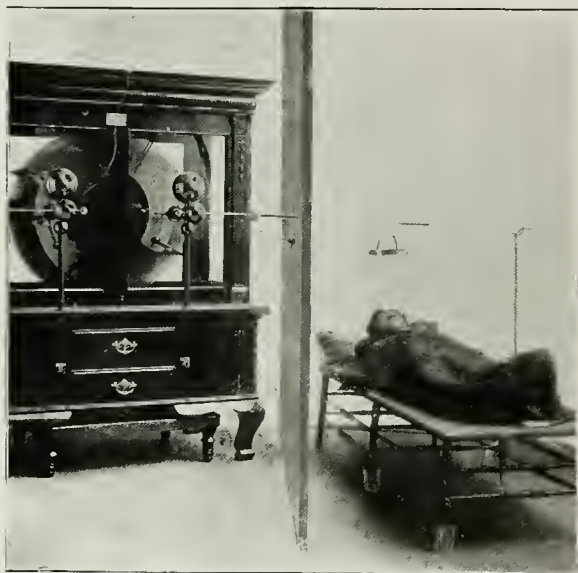
The breeze of static electricity is a current of electrified air thrown from the point or points of an electrode to the body of the patient. The density of the current depends on the surface of the electrode and the number of metallic points implanted. The energy of the breeze depends on the speed of the revolving plates, the state



Stationary Breeze to Forehead.

of the air, the condition of the clothing and the manipulation of the electrode. The patient may be positively or negatively insulated; both the positive and negative breeze are bland and sedative when applied to the bare skin.

Where insomnia is due to the irritation of auto-intoxication, the patient when placed under



Head Breeze in Adjoining Room for Insomnia.

the influence of the static head breeze will frequently go to sleep in from five to ten minutes, and remain asleep while the soothing influence of the static breeze continues, and frequently for hours afterward.

The breeze may be either movable or stationary. The movable breeze is usually the point or

brush electrode in the hand of the operator, and may be moved back and forth with a slow or rapid motion over the region to be treated.

Through cotton, linen fabrics and on the bare skin the negative breeze is cool and sedative, but applied through woolen fabric it may be made a



Movable Negative Spray Over Kidneys.

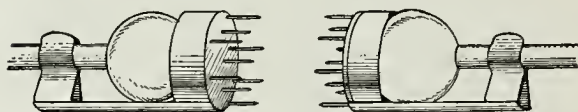
stimulant and counterirritant, reddening the skin and causing sensations of warmth which may last for some time, and may be made to blister in a few minutes, if this effect is desired. Cold extremities, sluggish circulation, hepatic pain and pelvic pain frequently yield to this form of treatment. Irritant effects may be increased by in-

creasing the motion of the plates and making an interruption between the prime conductor and the patient.

When the hair is thick, the negative head breeze may be unbearable. Metal ornaments and corset steels may cause burning or disagreeable sensations with the negative breeze.

SPRAY.

The static spray differs from the breeze only in the closer proximity of the electrode to the patient. It is more energetic in its action and therapeutic qualities than the breeze. It intensifies all the effects produced by the breeze. It is



These Shunt Terminals Permit the Giving of Positive Spray with Little Danger of Spark.

more sedative and calming when these effects are desired, and more irritating and rubefacient when the latter effects are indicated. When powerfully applied and concentrated with skill, it relieves a great variety of painful conditions.

Owing to its simplicity and mildness, profound and unique effects, this mode of treatment deserves careful study, as operative technique plays an important part in the comfort of this application.

With the indifferent pole grounded, the patient may be either positively or negatively insulated, though it is well to bear in mind that the negative spray is more irritating than the positive. To obtain a counterirritant or rubefacient effect, the parts should be covered by woolen clothing

or material of the same character. The irritating effect may be increased with the speed of the plates by interrupting the spray or bringing the electrode so close to the body that fine needle-like sparks will mingle with the spray. The spray acts as a sedative only on those parts which it reaches *en masse* and without friction.

In giving the spray, study the point of your electrode, which will warn you when to avoid a spark, which might disturb the patient. In giving spray, avoid all projections, such as the various angles of the face, that might draw off a spark. Slowly move up to where the violet-pencil discharge pours full upon the point you wish to treat.

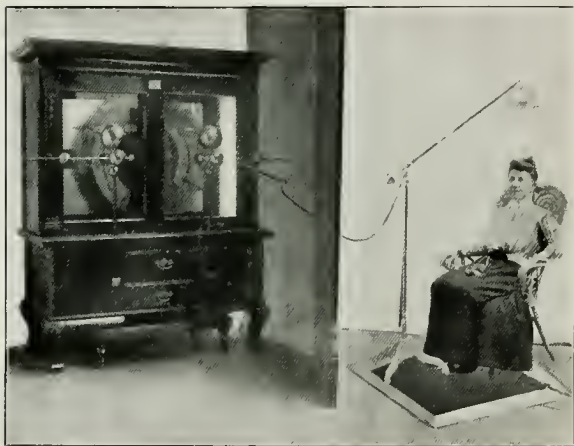
As it is not necessary to use the platform when we connect the spray electrode with the machine, we are able to treat timid patients in another room. We can do this by placing a heavily insulated wire through the wall and connecting the cord from the machine to this. We connect our electrode cord to this wire, which has a hook in our room. The current may be intensified by placing the patient on an insulated metal plate connected with a gas-pipe, etc. (A large piece of sheet rubber may be placed beneath the metal.)

Cataphoresis is an impossibility with static electricity. The action of the static spray in hastening absorption of local applications to the skin explains what was considered cataphoresis by many.

The positive breeze or spray, on account of its cooling, agreeable, as well as bland and sedative qualities, is very grateful to the patient and may rapidly relieve such painful conditions as neuralgias, muscular rheumatism, hysteria, painful inflammatory conditions and nervous headaches. The headaches not reached by the static breeze are usually due to some active continuous cause,

such as anemia, neurasthenia, dyspepsia due to malnutrition, etc.

The ozone generated by this mode of treatment exerts a beneficial effect on mild cases of pulmonary tuberculosis. It must be borne in mind that the decomposition of the atmosphere results in the production not only of ozone, but also of nitric acid, which is an irritant. Either of these substances would undoubtedly destroy bacilli, if



Static Breeze in Neighboring Room.

brought in contact with them. These substances can be best localized by means of a stationary spray (from a wooden ball electrode) so placed as to give him the benefit of the decomposed air by inhalation.

The sedative positive spray finds a large field of usefulness in:

1. Acute rheumatism.
2. Acute swelling of joints,
3. Lingering pains of subacute rheumatism,

4. Simple conjunctivitis,
5. Simple laryngitis,
6. Simple coryza and hay fever, where the antiphlogistic action dries up excretions of a serous or suppurating nature.
7. In nausea, spraying the region over the solar plexus and pneumogastric nerve frequently brings hasty relief.
8. It removes heat and itching from superficial inflammations, eruptions and burns and
9. It relieves the itching mucous tissues of the mouth from which diseased teeth have been extracted.
10. It not only relieves pain, but hastens the process of repair in fractured bones by relieving the condition of stasis.

The static negative spray may be used wherever a counterirritant is indicated, and is especially efficacious in:

1. Grip and malaria; this spray over the liver, spine and spleen frequently accomplishes great good.
2. Impaired sensation,
3. Chronic torpor of certain tissues,
4. Cold extremities,
5. Deranged circulation,
6. Bronchitis,
7. Injuries,
8. Pleurisy,
9. Nausea, etc.

A hot spray over the course of a nerve is very effective in relieving an attack of neuritis and affords prompt and wonderful relief in cases of gastralgia, cardialgia, nephralgia, ovaritis and neuralgia of the liver so common in diabetes.

In treating an attack of neuritis or neuralgia of the face or hands it is well to cover the parts

with a flannel cloth, as the skin is a very poor conductor and the tendency is to a dissipation of the charge.

The brush discharge is a discharge similar to the spray, a wooden (soft maple, white wood) ball or point electrode is used on the grounded pole, as it delivers a fine discharge without any



Brush Discharge in Conjunctivitis.

disrupted qualities as sparks. The electrode may be frequently soaked in water, as the discharge becomes less vigorous when it becomes dry; heating the electrode during cold weather increases the effect of the discharge.)

The intensity, volume and effect of this discharge vary with the speed, capacity of the

machine, nature and size of the electrode, character of the patient's clothing and the atmospheric conditions. The effect of the brush discharge on a wet surface or on wet clothing is entirely lost. Cotton or linen impairs its action, while woolen clothing over the surface to be treated favors strong effects.

When applied for a long period the effect is at first rubefacient, and later vesicant, finally producing painful blisters. Open surfaces must be avoided, as most of the current will enter the raw spot and cause pain.

This discharge lessens local hyperemia and congestion by contracting the arterioles, thereby relieving pain and diminishing swelling to a marked degree. Metabolism is increased in the end organs, and healthy restorative action is induced.

The nature of this electrical discharge decomposes the atmosphere, developing ozone in so close a proximity to the skin or diseased tissue as to render the site of application distinctly aseptic by oxidizing organic life. It is owing to this property of the current that lupus, eczema, herpes, acne and scabies are wonderfully relieved and cured by its action. Swellings associated with fractured bones, sprains and abscesses rapidly disappear. It has a wide field of usefulness in cases of gastralgia, neuralgias of a superficial nature, coccygodynia, pruritus and myalgias.

Ozone sprays heal granulations and deodorize fetid odor in sores.

A high-frequency current may be obtained from the static machine by employing vacuum tube electrodes. The discharging spark gap is essential, for without it there is no appreciative interruption, no frequency. The spark gap between the balls of the discharging rod must be

regulated to the condition treated. It is not necessary to insulate the patient as in other static modalities.

In the treatment of the air passages, medicated air, or medications held in suspension by the air, are used with more or less success, even with the very simplest forms of treatment, such as suck-

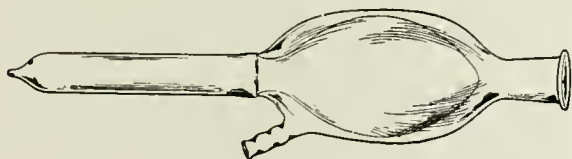


Positive Spray, Ulcerated Surface in Mouth.

ing the air through a wash bottle containing the medication, or the inhalation of a medicated spray from an atomizer or a nebulizer. Nebulizers are used with more success for inhalations, because the substances held in suspension by the air are broken up into very much smaller particles than from an atomizer. In fact, there is considerable

competition between manufacturers of nebulizers as to which nebulizer breaks up the medication the finest, producing a more perfect vapor for inhalation. The finer the particles held in suspension by the air, the finer or smaller are the air-passages that may be reached.

The Hughes Ionizer is peculiarly adapted for use with a nebulizer, because the medicated air or vapor, in passing through the air chamber of the Ionizer, is acted upon inductively by the excited vacuum bulb, and undergoes changes which still further subdivide the particles held in suspension by the air to such an extent that they are rendered invisible. Connect the Ionizer to a nebulizer and it will be noticed before the current



Hughes Ionizer.

is turned on or the vacuum bulb of the Ionizer is excited that a cloud of vapor will appear from the opening of the Ionizer from which inhalations are to be made, but as soon as the current is turned on and the vacuum bulb of the Ionizer is excited the cloud of vapor almost or entirely disappears, showing that the medication held in suspension by the air is so completely subdivided and incorporated with the air that when inhaled it will reach the very finest ramifications of the air passages.

If the medication used is alkaline in reaction it will completely neutralize the acid effects indirectly arising from excited nitrogen combining with hydrogen, thus the ozone, which is pro-

duced in large quantity, may be utilized without any of the irritating effects as experienced in the use of ordinary ozone generators. This is easily demonstrated by sucking air through the Ionizer without the use of any medication of an alkaline character. It will be noticed that considerable irritation is produced, invariably causing the patient to cough, but as soon as the air



Hughes Ionizer in Use.

sucked through the Ionizer by the patient is made to contain medication, such as bicarbonate of soda or borax, the irritating effects of the inhalation entirely disappear. Deep, full inhalation may then be made without the slightest irritation.

The wide range of usefulness covered by a nebulizer is very greatly increased by the use of a Hughes Ionizer, and although the instrument is yet new, most gratifying reports are made by

those using the instrument, as they get results promptly and in conditions which did not yield to treatment without the Ionizer.

SPARK.

Place the patient on the insulated platform, the indifferent pole being grounded. Before starting the machine, pull the sliding poles far apart. As a rule it is not necessary to connect the patient with the prime conductor, as mere insulation of the current on the platform is enough to give patient all the spark he can stand.

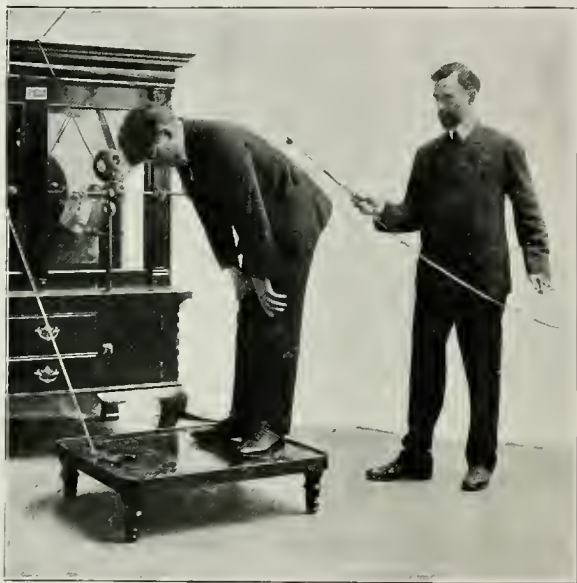
Use the grounded electrode for administration, as the spark, direct from the machine, is used only in cases of marked anesthesia. The spark is administered by throwing the metallic ball or point electrode with a quick movement to a point near the body, so that a disruptive discharge or spark takes place. The percussive discharge is a single discharge, thick, strong and clear cut. If the patient be negatively insulated, the spark is thicker, because the low voltage of the negative platform permits more current to accumulate on the positive electrode before it breaks the tension. The positive spark is milder in sensory effect and less penetrating than the negative spark.

The spark is varied in size by the electrode; exactly as large or small bottles hold varying quantities, so varying sizes of electrodes hold greater or less quantities of electricity. The spark depends on the charge and capacity of electrode. The potential quantity of electricity is analogous to the quantity of material fluid. The electricity resides on the surface of the electrode, and it is absolutely essential that the electrode be polished and smooth, as the current tends to divide and fly off the minute projecting points and edges. The size and length of the

spark are indicated by the depth of the lesion and its chronicity.

A large ball electrode is rarely used except in cases of impaired sensation.

It is rarely advisable to administer sparks at a first sitting, if the patient is a stranger. After



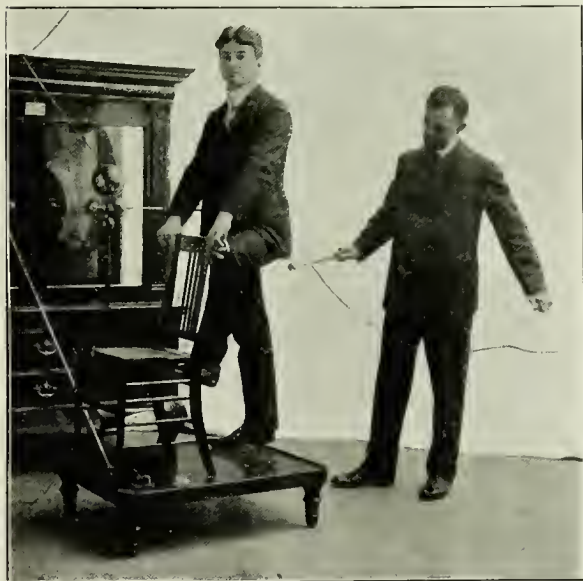
Posture in Treating Lumbago.

several treatments the system acquires a degree of tolerance and confidence.

The spark is not always found disagreeable, and a surprising number of patients will claim to really enjoy mild and skillfully directed sparks.

Sparks should be administered with some sense of regularity as to time and rhythm, for the tissues soon learn to anticipate the next spark.

Sparks rapidly following one another on the same spot cause unnecessary pain, and should be administered with an interval of time and change of base. Sparks should be avoided on all bony prominences, as the back of the hand, the finger nails, the dorsum of the foot, etc.



Posture in Treating Sciatica.

The breast, both in male and female, and particularly the nipple, is sensitive and should not be struck with a spark except for sufficient cause. The genitals, most of all, must be avoided.

Sparks on face, head and breast must not be applied unless the machine is in slow motion.

Moisture being a good conductor, perspiration

or wet clothing will conduct the electricity away and interfere with the action of the best machine. Over wet garments place a good non-conductor; even a newspaper will answer the purpose.

In administering sparks to the sole of the foot see that the shoe is dry, or it will form a spray



Giving Mild Spark, with Electrode Not Grounded, But Held at a Varying Distance From Floor.

instead of a spark. If the patient has on different thicknesses of clothing, draw off part of the current by means of the foot.

The static spark is the most active and far-reaching of all static modes, and produces widespread and strong muscular contractions, increasing molecular changes and thus aiding both

general and local nutrition. Sluggish and weak muscles are given renewed vigor; muscles and tendons long contracted are loosened and relaxed. Its action is especially beneficial in toning up the blood vessels, for it causes their muscular walls to contract and empty the stagnant venous blood into the general circulation, thus stimulating and regulating the functions of nerves, muscles and visceral organs.

When employing sparks, be governed in acute painful conditions by the relief afforded, taking care to give no unnecessary sparks, but applying them directly to the lesion, where they are certain to be the most painful. The patient soon discovers that sparks so applied are followed by greater relief and enters into the spirit of the treatment.

In cases of pleurisy, sparks in the surrounding tissues restore mobility and relieve pain.

In bronchitis, mild sparks promote expectoration and shorten the attack very markedly. In other affections of the lung, it increases the capacity of the lung for oxygen by its effect on the respiratory muscles and centers.

In treating nerve affections, cause the muscles to be moved about and held in those positions that cause most pain, and then give the percussive spark.

Under the influence of long percussive sparks, thickened and œdematous tissues, acute or chronic indurations and exudations are often resolved and soon absorbed, causing the tissues to take on a healthy aspect.

In fractures, sparks thrown into the joints will increase the mobility very markedly.

In chronic inflammation of joints, thick percussive sparks into the joint are very effective.

In locomotor ataxia give spark to plantar region of the foot. The number of sparks needed

will depend on the tissues. It should be continued until they respond and become warm.

It must not be forgotten that there are people with hypersensitive skins as well as anesthetic skins, and a small spark will sometimes produce excruciating pains.

In old age, sparks applied all over the body have a wonderful rejuvenating and tonic effect on the body, and are a great aid to any medicine the patient may be taking.

In patients with sluggish circulation, the sparks are frequently followed by a mottled appearance of the skin, which may persist for two or four hours.

FRICITION SPARK.

The friction spark may be used during humid weather when the direct spark will not work. The patient may be positively or negatively insulated, and the active pole may be used either direct or grounded.

The electrode is rubbed over the surface of the clothing, or the electrode may be covered with flannel and then rubbed over the bare skin. The discharge consists of a number of fine, minute sparks, varying from one-fourth to one-eighth inch, according to the thickness of the clothing. The positive spark is always milder than the negative, because it is given with negative insulation.

Place the electrode before starting the machine and separate the sliding poles gradually until the desired effects are produced.

The metallic ball electrode is, as a rule, preferable to the roller electrode, whose movements are restricted, and which does not slide freely in all directions as does the ball or blunt electrode, neither does it fit into the angles and depressions where you may wish to use it.

Friction sparks have marked counterirritant



Movable Spray in Rheumatism.

and rubefacient effects, and may be used whenever counterirritation is indicated.

Friction sparks are a splendid stimulant to the capillary circulation of the skin, and as the fine sparks perforate the cuticle (just as a piece of cardboard is penetrated by being placed between discharging rods), they hasten the absorption of any medicament it is desirable to employ.

The influence of friction extends far beyond the reddened skin, and reflex pains are often subdued by vigorous friction with the large brass ball over the region to which the pain is referred.

In paralysis, anesthesia, altered conditions of sensation, hepatic and ovarian pains, sparks are used with a great deal of satisfaction.

During the menopause, sharp counterirritation by friction over the cervical spine as well as around the pelvis gives a great deal of relief.

Friction sparks given from a rapidly moving wooden ball electrode over the affected surface



Wave Current, Electrode Under Feet.

frequently give prompt relief in rheumatism for about ten minutes.

In treating the spine or a larger surface, go over the tissues rapidly, and when treating a small surface, pause at short intervals, as the parts are very painful.

As a counterirritant, plain and simple static electricity cannot be surpassed by any drug (all effects from slight warmth to vesication may be

had); and the same principle that applies to drugs applies equally well to static electricity.

Investigation teaches that painful sensations travel along paths of least resistance on their way out (explaining reflex pains), and thus create a most direct route for the inward transmission of counter-electrical impressions that serve to annul pain.

Counterirritations of peripheral endings of sensory nerves are transported to the central nerve ganglia and are thus capable of producing organic changes; this shows how friction sparks operate in arresting cord disease. If, however, this relief does not go beyond primary palliation, the exciting cause has not been reached by the current and must be reached by some other means.

WAVE CURRENT.

Place the sliding poles in contact, ground the positive pole and connect the patient to the other pole. In utilizing this current, strips of flexible metal (block tin, etc.) or moist electrodes are applied to the affected parts beneath the clothing, and are connected to the machine by means of a flexible cord. Connection with the patient may be made at several places at the same time. The metal may be fastened to the cord by means of a spring clip or cuff holder. If the strip of metal is applied to the spine it is well to place the patient on a chair with an extra high back. A pillow at his back will keep the metal in snug position. The muscular contractions or pain over the inflamed area will determine the relative size of the metal electrodes and the spark-gap.

The current should not be felt more at one place than at another. It may be necessary to moisten the surface when contact is first made to avoid stinging sensations. After treatment

has continued, the spark-gap may be lengthened. This may be repeated several times during the treatment, which usually lasts from 20 to 30 minutes. The question is not how weak, but how strong the current can be administered without pain, to get the requisite local and internal effect on tissues or organs.



Wave Current, Electrode Over Cervical Spine.

If there is a long spark-gap, do not come near the platform with anything that may draw off the current and give the patient a shock.

The tonic effect is in proportion to the length of the spark-gap.

This is the most useful of the electro-static modes of treatment. Its superiority lies in the

fact that it is a one-pole current of high or low potential, great or small frequency, is under perfect control, is painless during administration and potent for great good. The patient being insulated, he is repeatedly charged and discharged from the surface of contact with the electrode, obtaining a local as well as a constitutional effect of general electrization peculiar to one pole.

In giving the general wave current, remove the shoes before putting the feet on the plate or insulate the feet by an excess of resistance by means of a magazine or other paper, so that intolerable sparks do not annoy patient's feet.

Profuse perspiration often follows an application; this is especially true in patients whose skins are active.

It lessens hyperemia and congestion, and relieves local pain by relaxing muscular spasm. It is very effective as a stimulant to general metabolism and a regulator of disordered nutrition exchange, and the so-called neuro-vascular gymnastics frequently bring about results superior to those of general massage, because it reaches parts out of reach by ordinary manual manipulation.

In sciatic rheumatism we find that intense vibrations are required and the spark-gap must be opened to the limit of the patient's capacity. Place one electrode over the site of the nerve exit and another over the ankle. When the electrode touches the motor points it is extremely painful. The spark-gap must be opened gradually.

In neuralgia and neuritis of whatever nature place the electrode over the congested and hyperemic spots, and especially over the motor points of the nerves.

In ovarian neuritis place the electrode immediately over the painful spot, on the abdomen and over the centers in spine.

In paralysis apply the metallic electrode to the

spine and treat for about forty-five minutes with a large spark-gap.

In asthma place the metallic plate over the spine and chest in front. Make the spark-gap



Wave Current, in Exercise of Wrist, After Fracture.

from four to eight inches, with an application of thirty minutes.

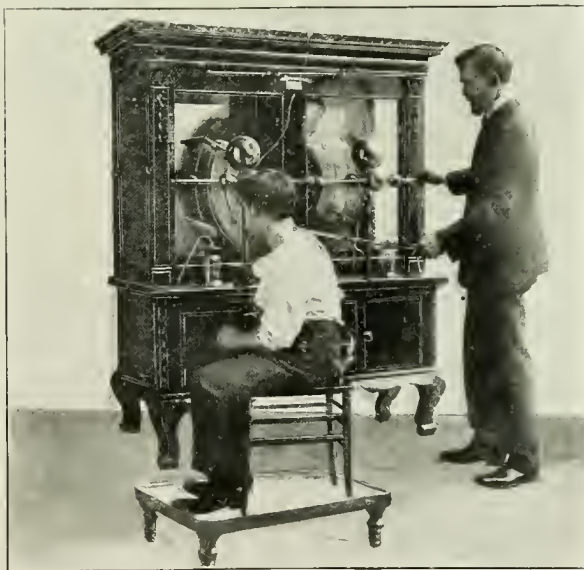
The wave-current treatment is very active and efficient in cases of gastralgia, angina pectoris, liver and kidney affections, pelvic neuritis, coccygodynia, irritable spine, etc.

In prolapsus uteri or enlarged and hypertrophied uterus, a metal bulb within the vagina; in prolapse of the rectum or enlarged prostate a rectal bulb appropriately placed within the rec-

tum will frequently bring about astonishing results.

A swelling action may be brought about by placing the ball electrode over the muscle we wish to exercise, and by drawing the sliding rod just beyond full dosage and returning it quickly. This applies to the muscles of the hand, leg, thigh, arm, chest. This treatment, applied by means of an electrode over the perineum, stimulates the secretion, circulation, nutrition, and the nerve energy is powerfully stimulated.

By modifying our technique we may get all the vaso-constrictor effects of a rapidly interrupted fine coil current. The muscles can be slowly or rapidly contracted, this effect being regulated by the distance between the sliding poles and the

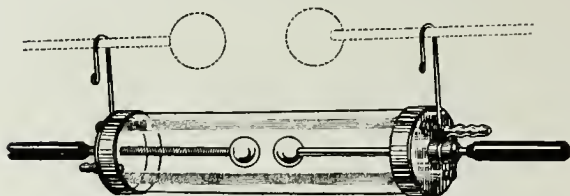


Stimulation of Spinal Center by Interrupted Current.

speed of the plates, manipulation of the electrode and duration of contact.

By applying a very small electrode over the eye, with a small spark-gap and the machine in slow motion, we obtain a wonderful tonic effect for tired eyes, blepharospasm and especially in that condition accompanying kidney affections, where glasses fail to give any relief. A half minute's treatment frequently gives relief for twenty-four hours.

The application of this current can be localized to any part, great or small. The slowly repeated powerful interruptions are exceedingly stimulating, while the more rapid the interruptions, the



Spark Muffler.

finer and more sedative is the effect. It answers well for many of the local indications for sparks, while it seems to lack little of their power to rapidly remove localized or deep-seated pains in fibrous tissues. It is a comfortable method which will produce identical results in many cases to which sparks can not be applied.

LEYDEN JAR CURRENTS.

With the sliding poles closed and the machine in motion, gradually draw apart the poles after applying the electrodes. The passage of the spark between the discharge rods is accompanied by a painless contraction of the muscles in the



Leyden Jar Current in Chronic Laryngitis.

region covered by the electrode. Use a sponge electrode moistened in a solution of bicarbonate of soda; the sponge must not be too large, as it destroys the efficiency of the current density, requiring too large a spark-gap, thus sacrificing rapidity and smoothness.

The Leyden jar current is regulated by the speed of the plates and the distance between the sliding poles. Though various sized jars may be used, we can so adjust the distance between the poles as to make the largest jars produce practically the same effect as the smallest jars.

If the current causes pain over a hairy spot, lubricate it with vaseline or soap and water.

There is no contrast of pole action as in gal-

vanic electricity, though the positive pole has a higher voltage and a sharper bite on an abraded surface.

Leyden jar currents are used in the same manner and with the same electrodes as the faradic current. The difference between the effect of Leyden jar currents and the faradic currents on nerve and muscle is very little.

There is scarcely a pain due to traumatism, sprain, congestion or neuritis that is not benefited by the Leyden jar treatment. Its use is found chiefly in chronic cases, as in—

Rheumatism,
Rheumatic arthritis, small joints,
Gonorrheal rheumatism,
Gout,
Sciatica,
Chronic pharyngitis,
Chronic laryngitis,
Pains of various kinds,
Circumscribed burns,



Electrode for Treating Chronic Laryngitis by Means of Leyden Jar Currents.

Poliomyelitis—restores muscular tone and warmth to entire limb and prevents arrest of bone growth.

Edema of extremities,
Biliary lithiasis,
Occupation neuroses,
Chorea,

Locomotor ataxia—removes lightning pains and promotes feeling of well-being.

The author has found that the Leyden jar current is very efficacious in the treatment of a number of cases of relaxed kidneys. The accompanying gastric symptoms, as well as the



Leyden Jar Current to Spinal Center and Solar Plexus.

bearing-down and tired feeling, frequently disappear after two treatments. Two sponge electrodes about the size of the hand are used; one is placed on the back over the kidneys and the other over the solar plexus in front.

Many cases of Bright's disease are undoubtedly due to faulty digestion and chronic indigestion, with the consequent auto-intoxication. As

these cases are less violent than the cases of nephritis following infectious diseases, they are ordinarily neglected, and attention is only drawn to the actual condition present by the mental and nervous irritability of the patient. This condi-



High-Frequency Current in Appendicitis.

tion is greatly improved by local applications of the induced current, one electrode placed over the liver and the other over the kidneys.

The author has seen reaction from this form of current not obtainable from the strongest application obtainable from faradism, both coarse and fine wire coil. It may be used in the vagina, uterus and other internal cavities.

DOSAGE OF STATIC ELECTRICITY.

The dosage of current necessarily varies with the rapidity of the revolutions of the plates and in the manner of conducting the current to the patient.

The duration of treatment will depend on the pathological condition presenting itself. This condition will indicate whether the treatment should be repeated daily, or less often, and whether the treatment should be of a stimulating or sedative nature. It must also be borne in mind that a stimulating treatment for one patient may act as a sedative in another.

General electrification by insulation or the wave current usually requires from twenty minutes to one-half hour.

A sedative treatment, with spray or breeze, may last from ten to twenty minutes.

Stimulating and counterirritating treatments must of necessity be short and last from one-half to two minutes.

Acute and painful diseases should receive daily treatment until improvement permits of longer intervals.

Chronic cases must be seen at least three times a week.

An overdose or too prolonged treatment may be followed by weariness and a sleepy condition, never dangerous and always relieved by rest.

HIGH FREQUENCY CURRENTS.

At the present time two classes of apparatus are in use for the production of high potential currents—the static machine and the various modifications of the induction coil used in X-ray work, the voltage and frequency of alternations of which are still further augmented by means of the Leyden jars or Franklin plate condensers that connect the secondary windings of the Tesla coil or the Oudin resonator. The origin of the currents seems to be the external armature of the condenser, but they are dependent in a measure upon the current which charges the internal armature of the condenser.

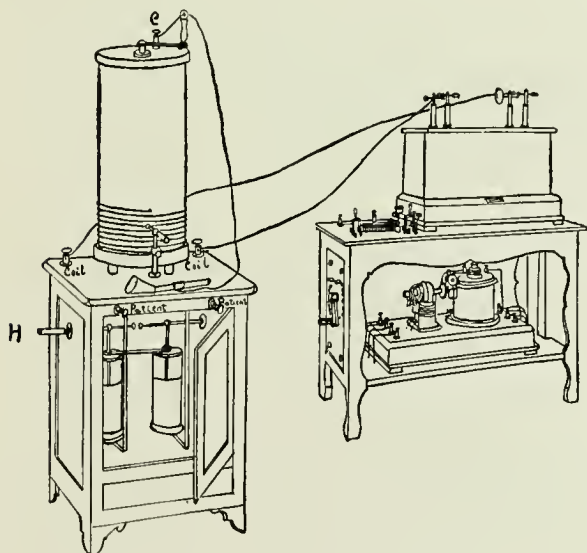
The organism treated with the high frequency current receives, or at least becomes charged with, a current of 100,000 volts, the alternations (first positive, then negative) of which would be the fabulous number of one billion or even higher per second.

When we remember that the greatest number of vibrations that can be appreciated in the production of sound is thirty-six thousand per second, we will admit that the term high frequency is well merited.

The alternations of an ordinary Rhumkorff coil are about two hundred per second and the electro-motive force of from ten thousand to two hundred thousand volts, while the alternations of the high frequency currents are millions per second and the electro-motive force from one hun-

dred thousand to one million volts, this, of course, depending on the means employed.

The dose ranges from 150 milliamperes to 700 milliamperes. With high frequency such a dosage is not at all dangerous if judiciously applied, while it would be extremely dangerous if lowered to 100 alternations, the usual rate.



Oudin Resonator Attached to X-Ray Coil.

It must further be remembered that the high potential is, in fact, obtained at the expense of the current, the latter diminishing in proportion as the potential or electro-motive force is raised by each successive step up in the transforming apparatus.

This current differs from all others. The energy produced is a transmitted vibration which

is carried or conducted by all solid substances (glass or hard rubber and other non-conductors), irrespective of their electrical conductivity, and has been compared to a sound-wave vibration which passes through solid barriers by causing the particles to vibrate at its own rate of frequency. It passes through glass, though this



High-Frequency Current in Mastoiditis.

would resist the passage of a continuous current even if the voltage were high. This explains the apparent ease with which the current passes through the body without giving rise to any unpleasant effect, resulting from the current overcoming the resistance. This current produces a vitalizing and invigorating effect without undue

stimulation. It is the nearest approach to vital force that has been produced.

According to Tesla, the innocuousness of these currents is accounted for by their not penetrating the body at the point of contact with the electrode, but perpendicularly to the skin and equally over the entire surface of the body.

D'Arsonval, on the other hand, believes that the motor and sensory nerves are organized to only respond to vibrations of a certain frequency.

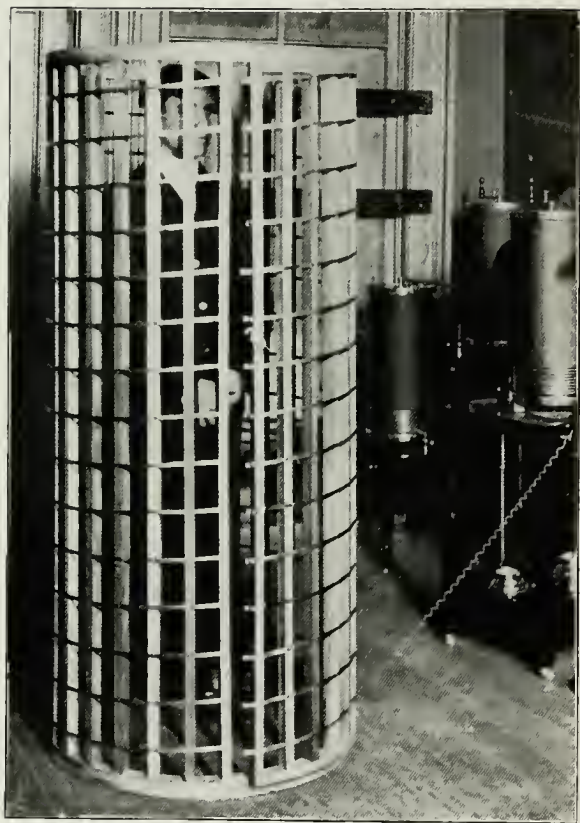
In producing muscular contractions a current of from twenty to thirty excitations per second is necessary. As the number of alternations increases the different contractions succeed in fusing together, the muscles becoming tetanized up to a rate of vibration of from twenty-five hundred to five thousand alternations per second. After this point has been reached tetany becomes less marked until no appreciable sensation is experienced.

When the number of excitations reaches a height which is distinguished as high frequency, all neuro-vascular reaction is arrested. It is possible that the motor and sensory nerves are so organized as to respond only to vibrations of a determined frequency, as does the optic nerve, the terminations of which respond only to undulations between four hundred and ninety-seven billions (red) and seven hundred and twenty-eight billions (violet) per second. To the infra-red and the ultra-violets we are blind.

In the same manner our auditory nerves are impressionable to vibrations of a certain rapidity only. Musical sounds corresponding to vibrations which are too slow or too rapid are not perceived.

The high frequency currents are applied:

First: By auto-conduction, when the patient is



Auto-Conduction with High-Frequency Solenoid.

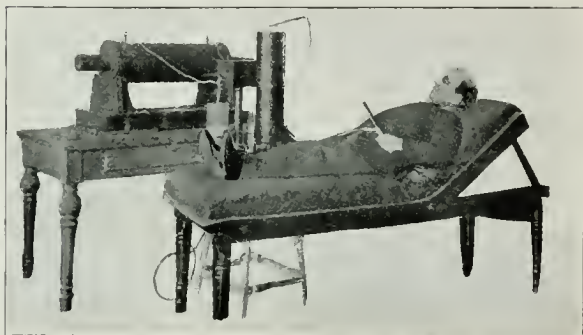
enclosed in a solenoid of copper wire, the ends of which are connected with the terminals of a high frequency coil. The noteworthy method of this treatment is that the patient is not in contact with the solenoid. The solenoid may be large enough to envelop the patient entirely, or large enough to enclose an arm, a leg or the chest. The passage of the current through the cage induces, by mutual induction, high frequency currents in the tissues of the patient, which may be demonstrated by a spark being drawn from him at any part. That is to say, he is saturated by being placed in the field of the current.

If a lamp of twenty volts is used to close the circuit of a single coil of thick wire, it illuminates with a brilliant light at a distance of more than three feet.

When placed in the solenoid, absolutely no sensation is experienced, not even the slightest muscular contraction, but on placing a rabbit within a solenoid traversed by high frequency currents, the vessels of the ear become rapidly dilated, shortly followed by a contraction equally energetic. Upon man the effects are similar and the skin soon becomes reddened and covered with perspiration. There is no increase in the body temperature, as excessive heat is lost by radiation and evaporation.

Second: By auto-condensation. This is achieved by making the patient one armature of the condenser, while the other consists of a large sheet of metal placed on a couch covered with cushions filled with insulating material, separating it from the patient, who holds in his hands metal electrodes connecting with the other end of the solenoid. These handles should be large and firmly gripped. The sensation of turning on the current is sometimes that of pricking by

needles and pins, but usually passes off quickly, being at no time disagreeable. An ordinary arm-chair properly prepared may be improvised for the purpose of condensation, lining the chair with a metal sheet and placing the patient on insulated cushions. With efficient means, we may pass four to five hundred milliamperes through the body. The patient is charged and discharged at each oscillation of the condenser. The patient may be connected with only one end of the ap-

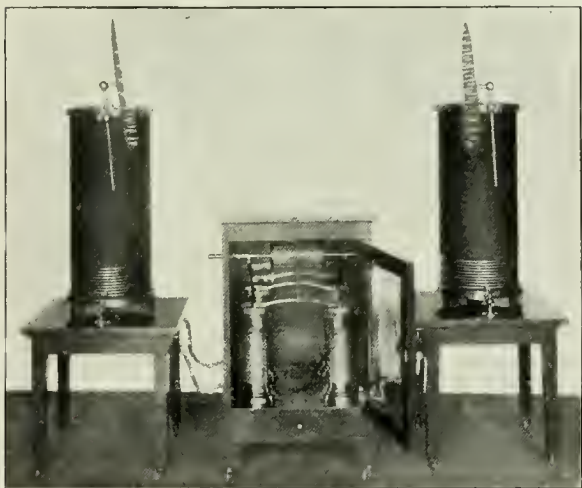


High-Frequency Couch.

paratus. This is usually termed the monopolar method; on account of the enormous voltage air ceases to be an insulator and the current passes without conducting wires. In this method the connection is taken from the top of a resonator.

A resonator is a piece of mechanism whose construction is such that it is capable of vibration. Most of us have seen the experiment of two tuning forks, tuned to the same pitch, set close to each other. If one be set in vibration by a blow, the second fork will start vibrating by itself. Because it is vibrating in unison with the

former, it will reinforce the sound given by the first vibrator. Similar phenomena can be produced in electrical apparatus and by electrical vibration. Oudin was the first to use a resonator in electro-therapy. His resonator was constructed of a helix of wire of suitable length and diameter appropriate to the capacity of the inductor. When



Oudin Resonators.

the solenoid was excited an induced current appeared in the second solenoid or helix, which by regulation could be made to vibrate in unison with the inducing solenoid. When the two solenoids were vibrating in unison a torrent of soft sparks would be seen emanating from the end of the induced solenoid.

The patient may be connected with the solenoid by means of two large hand electrodes. The current will pass through him by derivation, as,

owing to the phenomena of self-induction, the solenoid will offer a great resistance. To obtain a perfect contact the handles may be wrapped in wet flannel or covered by a sponge. If the connection is imperfect, small sparks may be observed to pass. If we wish to increase the area of penetration and lessen the obstruction of the skin a hand or foot bath may be used.

If the contact with the metal electrode is imperfect a small ulcer may be produced.

With local treatment, ocular evidence will be the guide. One must always bear in mind that local treatment, whether by effluve or otherwise, will, if persisted in for any length of time, cause inflammation on healed or healthy parts. The dosage requires as much discretion as any other therapeutic measure. It is frequently noticed that patients having pain at the commencement of a sitting may find it somewhat increased after energetic treatment. Defective contact between the apparatus and the patient may mean unpleasant sensations or even a shock.

Various shaped vacuum glass tubes are used as high frequency electrodes and owe their existence as electrodes to the therapeutical benefits derived from X-ray treatment. In X-ray therapy the benefits derived are undoubtedly due to the high mode of motion imparted to the rarefied air in the X-ray tube, and if this high mode of motion be capable of producing such remarkable therapeutic effects, will not a similar mode of motion imparted to the rarefied air of other vacuum tubes (made into various shapes and sizes so to be better adapted for treatment) produce similar effects?

Vacuum tubes used as high frequency electrodes are exhausted the same as an X-ray tube, as the results obtained from their use depend

largely upon the degree of vacuum; and it has been found by experience that a sufficiently high mode of motion should be imparted to the rarefied air in the tube to produce the same color as in an X-ray tube capable of showing the bones in the hand.

The high frequency electrodes are excited by an inductive action. Instead of conducting the current through the tube, the tube is provided with a metal socket or clamp to which one ter-



High-Frequency Current in Acute Conjunctivitis Due to Cold.

minal of the high frequency apparatus is attached, and the strength of the inductive action, arising from the tube when thus excited, depends upon the regulation of the tension of the current produced by the high frequency apparatus. The inductive action arising from the tube may be employed in various ways. The distinctive work to which these tubes are adapted is similar to that for which the X-ray is employed, as in treating abnormal cell conditions involving superficial structures. The tubes are not adapted to treating deep tissue, as with the X-ray, and do not have any effect upon the deep tissue of a

character like that produced by the X-ray; therefore they may be applied effectively in the treatment of superficial structures without fear of producing burn, thus doing away with the necessity of protecting healthy tissue. The only effect noticed from overexposure with these tubes is a slight dermatitis or sunburn effect, and the peculiar energy emanating from these high frequency tubes, similar in character to that emanating from X-ray tubes, may be employed with success in treating skin diseases, such as eczematous conditions, acne, lupus, minor epithelioma, etc., and in conditions involving the mucous membrane lining the cavities of the body.

Whatever is the true solution or explanation for the effectiveness of this current, it, nevertheless, remains a fact that the effects of the current are felt deep in the body and have a powerful influence over nutrition in a variety of ways.

Experiments prove that we have electrical currents traversing the body in every direction, and that the nerves are the carriers of the current. It is also true that everything that acts as a carrier of an electrical current vibrates. In perfect health the nerves are constantly vibrating. The rate of vibration is peculiar to the kind of current carried by the nerve. Whenever a nerve loses its normal vibratory tone, its function is impaired, but if placed under the influence of the high frequency current the patient is subject to a series of vibrations, from a few to many millions per second. This being the case, every nerve in the body will find a current to which it will respond, and they will vibrate accordingly. A nerve once started vibrating normally usually continues to do so, and at least acts normally while under treatment.

The strong tonic action on the vaso-motor

system flushing blood through the capillaries, opening sweat glands, relieving local congestion, causes a general sensation of warmth in the body.

Its effects are a double one, stimulation of the trophics, sedative to the sensory, tonic upon the unstriated muscular fibres locally, and cerebro-spinal and sympathetic nervous system generally.

Respiratory movements are augmented, and careful measurement shows an increased absorption of oxygen and increased elimination of carbonic acid gas, varying from 15 to 30 per cent.

The inhibitory action of the current is proven by several experiments. Under its influence the excitability of the tissues to other stimulation is decreased; local anæsthesia occurs to the point of penetration, and may last from one to twenty minutes; the sensibility of the skin to galvanism and faradism is greatly lessened after the passage of a high frequency current.

In consequence of the great quantity of ozone generated, this current has great bactericidal power, and has been found to destroy the toxicity of various toxins.

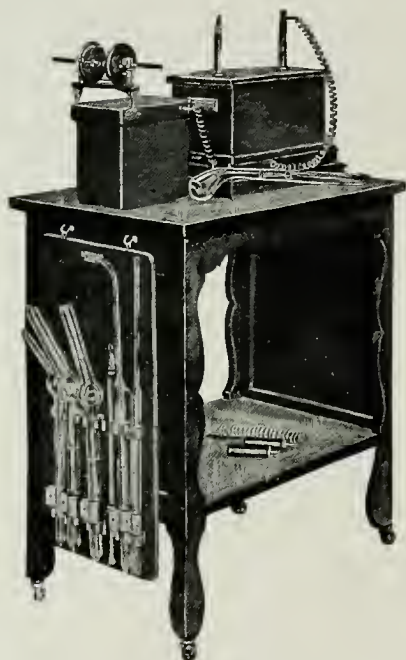
These currents, after a few minutes' application, will frequently relieve the severest pains, and are very effective in the various neuralgias.

Its action on the mucous membrane is demonstrated by the disappearance of some cases of persistent hemorrhoids, anal fissures and ulcers of the rectum. It not only allays the irritation, restores tone to relaxed fibers of blood vessels, muscles and nerves, but restores the power of the impaired sphincter and removes the product of morbid nutrition. (If the cause, as torpid liver, etc., is still actively present, the relief will, however, only be temporary.)

Treating females about the rectum, near the menstrual period, sometimes brings on a premature flow. This fact may be utilized in treating

virgins for delayed menstruation, when vaginal manipulation is undesirable.

Nervous dyspepsia and atonic dilatation of the stomach, so stubborn to ordinary routine treatment, yield readily to treatment by high fre-



Tesla Coil and Franklin Condenser.

quency currents. After a number of applications, varying from ten to twenty, the stomach shows a marked improvement in size and position, and in the process of digestion. The improvement is probably the result of the restoration of a normal circulation and blood supply to

the gastric glands, the consequence of the return of the stomach to its natural size and position.

The improved circulation is probably due to the tone given to the tissues directly or indirectly through the vagus to the unstriped fibers which constitute the muscular walls of the stomach. This toning up enables the stomach to empty itself after each meal. The retention of imperfectly digested food ceases, and with this the absorption of the abnormal products of digestion and the consequent symptoms of auto-intoxication and neurasthenia. One writer reports favorable results in several cases of chronic diarrhœa and dysentery.

Stout people lose weight during the continuance of this treatment, while the thin and emaciated gain steadily.

Acute indigestion is frequently relieved and the peristaltic condition of the stomach started by a few moments' treatment over the region of the solar plexus by means of a glass electrode.

Atonic dilatation, gastric indigestion and malnutrition in infants have in the author's experience responded, after a few treatments, when other measures in the hands of able men have failed. The treatment was applied by means of the vacuum tube over the solar plexus and over the entire spine.

The high frequency current has a powerful influence on the mucous membrane of the stomach and the intestines. A number of authors believe that these parts of the body may be best reached by applying one metal electrode to the surface of the tongue and another within the anus. Electricity passing along the lines of least resistance will pass mainly along the mucous membrane of the alimentary tract. Especially good results are claimed in gastric ulcers, chronic gastritis and chronic catarrh of the intestines.

These currents are effective in the various inflammatory conditions, such as epididymitis, tonsillitis, beginning otitis media, and even mastoiditis. Marked relief is frequently obtained after one treatment, where, before the introduction of these currents, operation was the only resort.

In tuberculosis of the lungs the patient usually begins to breathe more freely after a local application over the chest of a shower from the vacuum tube about one-half inch long.

The action of high frequency by auto-induction on tuberculous guinea pigs has proved that an actual inflammation is produced around the pulmonary foci, and that finally this abates and leaves the lungs clear of bacilli. High frequency currents in any form are able to produce modifications in the tissues and make the body cells more resistant to the inroads of the tubercular bacilli. The leucocytes are usually greatly increased during the course of treatment.

This current is indicated in all diseases due to errors of nutrition, as obesity, diabetes, nephritis, gout, rheumatism, anæmia and chlorosis. The best results in chronic cases are obtained by giving the treatment not only over the kidney and liver, but over the whole body. The duration of the treatment may be from a few moments upward, according to the subjective symptoms. A patient overdosed may feel a certain degree of lassitude, lasting more or less for several hours, or, on the other hand, may feel brighter or invigorated. The actual dose must be capable of variation.

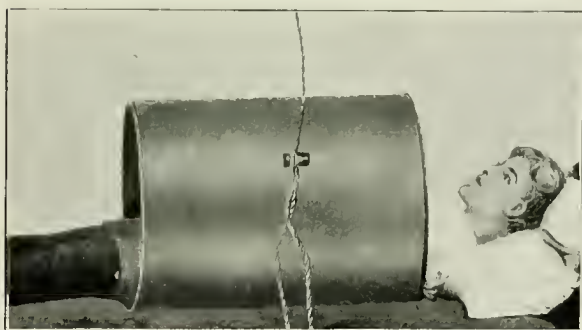
AN ALTERNATING-CURRENT SOLENOID.

Wherever facilities exist for obtaining an alternating electric light current this apparatus can

be used. (The direct commercial current cannot be used unless changed by a transformer.)

The apparatus consists of an induction coil, made to be worn around the body. The solenoid produces effects resembling the physiological action derived from a high-frequency auto-induction solenoid. A small incandescent lamp held in the center of the solenoid will glow without contact with any circuit.

That electricity favors rapid growth in plants has been known for some time, but only recently

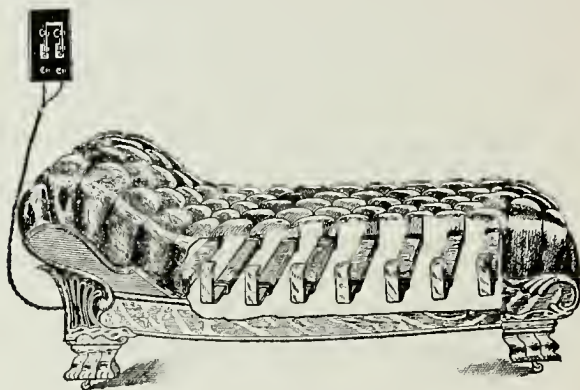


Patient in Solenoid.

it has been discovered that animal metabolism may be augmented by electricity, which is satisfactorily demonstrated by the fact that guinea pigs and rabbits placed in an electrical solenoid will grow twenty per cent faster, and be more robust than animals of the same litter not so exposed. The author can say from personal experience that it has a similar effect on children of backward growth, both physically and mentally, as the following case will show:

A boy seventeen years old had not increased any in height or weight since he was eleven years

old. During this period of six years he had been under the care of able physicians in various parts of the country. The last two years had been spent in the mountains under the care of a physician that laid great stress on physical culture, etc. This treatment hardened the boy's nature, but did not assist his growth. The boy measured four feet nine and five-eighths inches and weighed sixty-seven and a quarter pounds. An X-ray examination showed that the ends of the



Alternating Current Couch.

boy's bones were not yet ossified, hence there was still hope for growth. The boy was otherwise in perfect health.

Under influence of static electricity, alternating solenoid and oil rubbings for one month, the boy grew three-quarters of an inch in height and gained three and a half pounds in weight. He was then taken to California in the hope that the mild climate of that country would help him grow now that he had a start. On returning at the end of seven months he was found to have gained about three-quarters of an inch, or about

one-eighth inch a month. He was again placed under treatment, and under the use of the solenoid alone (static electricity being omitted) and oil inunctions gained about one-half inch each month for the next five months.

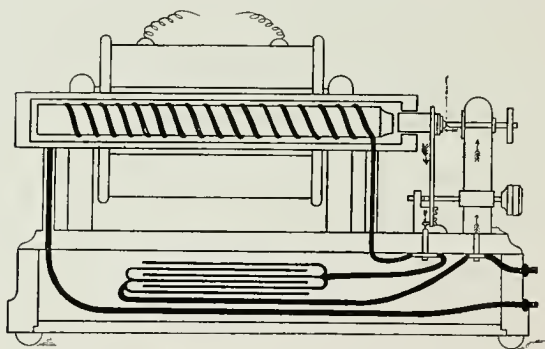
In the author's opinion oil is an important element in hastening growth, as is seen in children suffering from rickets. But that oil alone will not bring about such rapid growth was demonstrated by cases who had received oil rubbings for some time responding and making more rapid progress when the solenoid was used.

A couch may also be used with the alternating commercial current on the same principle as the solenoid. That magnetic waves surround the patient lying on the couch is shown by lighting a lamp held over the couch.

On a person in perfect health there is no apparent effect, while a patient tired or suffering from nervousness may become drowsy and gradually fall into a refreshing sleep. It stimulates the functional organs and the centers to nervous and physiological activity, and thus hastens elimination and promotes healthy tissue growth. As no technical skill is required to operate the apparatus, it can be placed in the patient's home and there employed under the physician's direction.

ROENTGEN OR X-RAYS.

The X-rays emanate from a mode of motion imparted to rarefied air in the tube, the tube being exhausted to about one two-thousandth of an atmosphere in order to leave the structures of air more free to move. A thin substance may be stirred more readily than a thick one with the same energy, and as the mode of motion imparted to the structures of the air must be a very high



Ruhmkorff Coil.

mode of motion in order to produce X-rays, it is necessary that the tube be properly exhausted, as a great deal depends on the vacuum in the tube.

So far the only means we have at our service for producing this intense bombardment and its consequent X-ray is the electric current. The X-ray is not some form of electricity, but is a higher rate of vibration even than light, and is

the transformed energy of the electric current. This latter is simply the mechanism for its production. Any other form of energy, which would bombard the metal plate with sufficient intensity, would also produce the X-ray, and it may be in the future some such other method may be discovered.

The apparatus used to excite an X-ray tube is either a static machine or one of the various modifications of induction coils. The Ruhmkorff coil transforms a low pressure current into one of

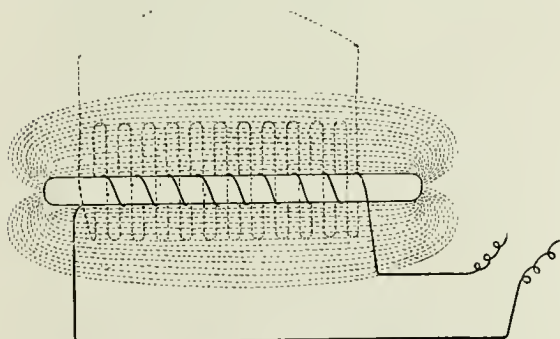
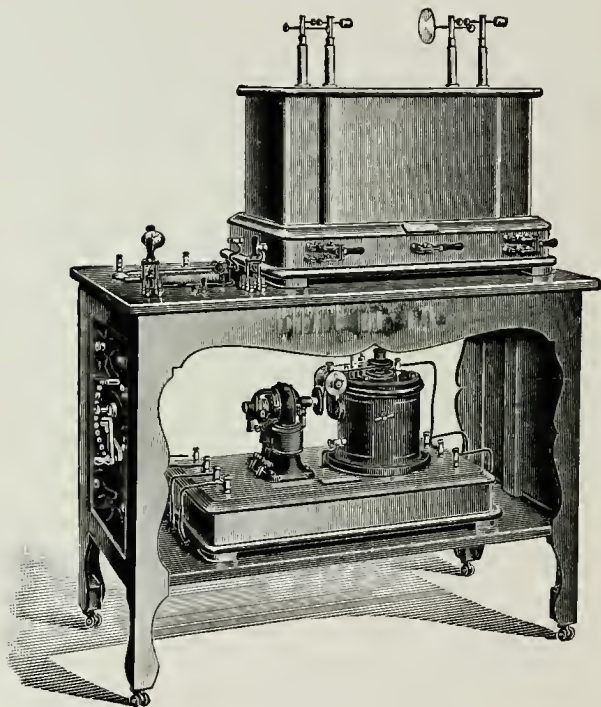


Diagram of Magnetic Field of Induction Coil.

high potential by means of an induction coil. To excite an induction coil it is necessary to bring two entirely separate and distinct circuits near each other, but not in contact. A current passing through one will, by mutual induction, produce an electrical current in the other, running in an opposite direction. If a break is made in the primary circuit, a secondary current is for the moment induced in the secondary circuit. If this make and break is done with great rapidity, the induced current will be one, continuously changing its direction; in other words, an alternating current.

The central core of a Ruhmkorff coil consists of a cylindrical bundle of thin, soft iron wires bound together and thoroughly insulated by being impregnated with paraffine wax. Around this core is wound the primary circuit, consisting

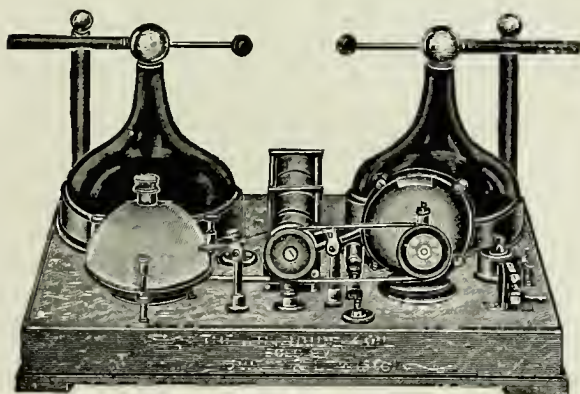


X-Ray Coil and Interrupter.

of a comparatively short length of stout silk covered copper wire, the whole being insulated with paraffine wax, and when cool pushed into a properly fitting ebonite tube to thoroughly insulate it from the secondary circuit. As the current is

passed through the primary circuit the iron core becomes magnetized and emits lines of magnetic influence.

The secondary coil consists of many turns of fine insulated wire (No. 36), thirty to sixty miles in length, wound around the primary and thoroughly saturated in paraffine wax. The secondary wire is coiled in sections to avoid the induction of the outer coil on itself, which, on account of the high voltage, is liable to take place, no matter

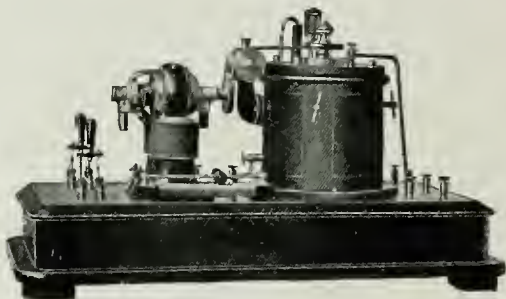


Kinraid Coil and High-Frequency Apparatus.

how thorough the insulation. The wires are covered with silk and each winding is separated from the others by a layer of shellac. The windings of the secondary coil are continuously being impregnated by the continuous flow from the iron core. The electro-motive force of the induced current is thousands of times stronger than the primary current, on account of the great number of secondary windings. The strength of the current is reduced by the increased voltage, as well as by the constant change of its direction.

The breaking of the primary circuit momentarily produces by self-induction a slight current in the opposite direction.

This self-induced current is absorbed by means of condensers, consisting of several layers of tin-foil, separated by sheets of paraffine parchment, the alternate sheets of the tinfoil being attached to one another. This absorbed current is discharged a moment later through the primary coil, thus creating a current in the opposite direction to the initial current, demagnetizing the core and greatly adding to the efficiency of the coil. A



Mercury Interrupter.

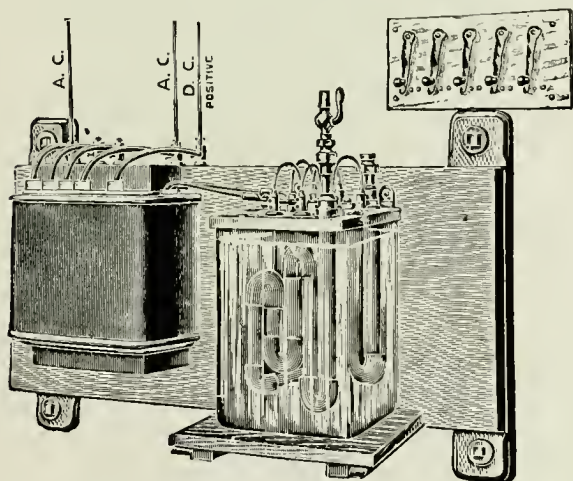
twelve-inch coil without condensers will barely spark two inches. High frequency currents may be produced with a six-inch coil, but the best results can only be obtained with one of twelve or more inches.

The Kinraid coil and high-frequency apparatus has the coils wound in a flat spiral, the secondary inside the primary, in such a manner that there is small likelihood of sparking between the ends of the secondary. The interruptions are produced by sparks across the space between two water cooled copper-plates and consist of oscillations made up of one principal and many (about twenty) minor surges of current in the primary

and consequently of the same number in the secondary coil.

The interrupters for the primary current in the coil machines may be divided into four varieties: The mechanical, the mechanico-electrolytic, the thermo-electrolytic, the electrolytic.

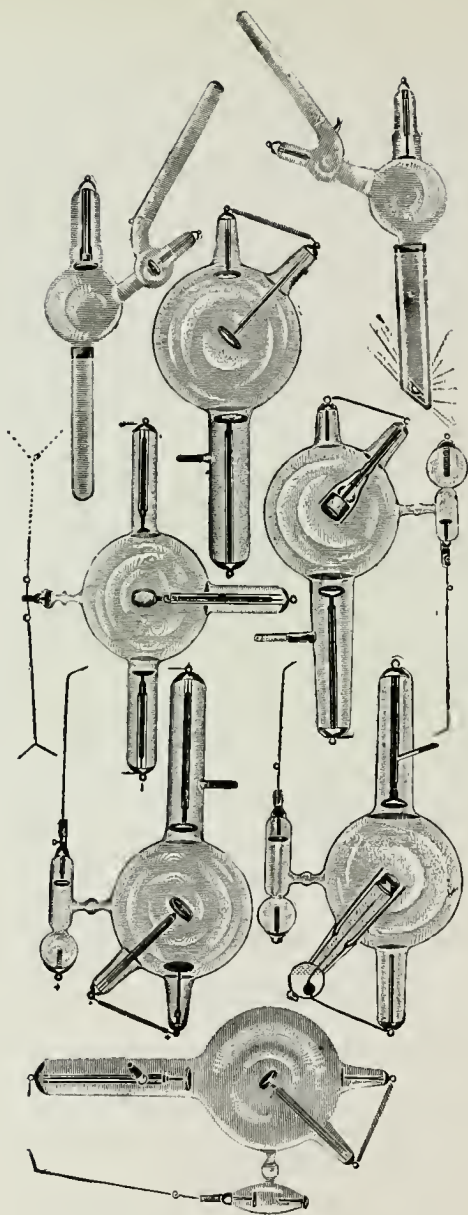
Light may be reflected, refracted and polarized; but not so the X-rays, which are the highest form of vibration we know of. The waves



Scheidel Alternating Current Rectifying Interrupter.

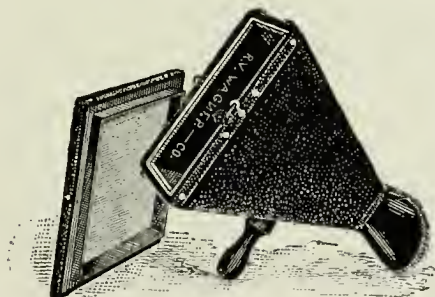
are undoubtedly too small to be reflected by any polish we are at present able to obtain, or to be refracted by any mechanism we are at present able to construct. The X-rays travel in straight lines and cannot be bent or diverged by a magnet or any other known means. They induce chemical action—are photographic and cause fluorescence.

The cathode stream in the X-ray tube consists of molecules of gas, still contained in the tube,



X-Ray Tubes.

and the negative ions moving in a free path on account of the tenuity of the vacuum. They move in straight lines from the surface from which they are given off, therefore the cathode is made concave, so that the rays may converge to a point on the target. After these rays meet to form a pencil, they do not diverge, but continue in a straight line until they meet some resistance. Therefore the target should be a little beyond the true focus of the concave disc. The cathode stream may be deflected by a magnet in the same manner as the electric arc, but



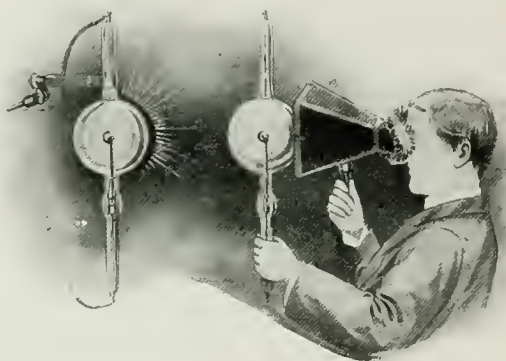
Fluoroscope.

the X-rays cannot. When the cathode rays bombard the target, there occurs a transformation of energy and the resultant X-rays are emitted in all directions from the point of bombardment.

As the X-ray is invisible it is necessary to have some medium to translate or transform it so that its manifestations can be perceived by the human eye. This is done by means of the fluoroscope. This consists of a piece of cardboard covered with a thin layer of some fluorescent substance, preferably platino-cyanide of barium. For convenience, this is made the base, fluorescent side inward, of a pyramidal box, of which the apex

is cut off and adjusted to the face about the eyes, so as to cut off all external light, in order that the fluorescent picture may be more distinct.

Why the platino-cyanide of barium becomes fluorescent we do not know. We recognize the fact that it does so and make use of it accordingly. Inasmuch as the X-rays pass through substances in inverse proportion to their density, it follows that the denser substances will cast the deeper shadows, and these light and shadows



Examining Quality of Tube.

make the picture on the fluorescent screen and photographic plate. Since the X-rays diverge from a small point on the target, the nearer the object is to the tube, the greater will be the magnification, and vice versa.

When the current is continuous, the higher the vacuum the greater the penetration, because as the molecules have a freer path they strike the target with greater force, and consequently the X-ray is more intense.

One thing not to be overlooked in an X-ray tube is the degree of resistance which the glass form-

ing the bulb of the tube offers to the X-ray. As the ray emanates from inside the tube it must pass through the glass forming the bulb of the tube before it can have any effect therapeutically or otherwise. Consequently, a tube that has the proper degree of vacuum and excited with proper electrical energy might be nil, so far as any therapeutical effects are concerned, if a glass of high resistance to the ray be used for the bulb. A bulb made of leaded glass would be equivalent to the use of a thin sheet of metal or screen between the tissue treated and a good tube.

To test a tube in this respect, examine it with the X-ray in the same manner as you would your hand, and you will find that a poor glass tube casts a denser shadow upon a fluoroscope than a good tube. A tube blown very thin, and of the proper quality of glass, greatly increases the penetrating power as well as the efficiency of the tube. The difference is readily distinguished if the tube be examined with the X-ray. No one would think of making X-ray exposure through a thickness of metal and expect good therapeutical results.

All X-ray operators employ the same general technique. The static and coil machines seem to be on an equal footing as far as the results are concerned. The same may be said of the great variety of tubes now in use, but one can never be certain of securing good tubes until he has given them a trial.

The X-ray operator should have several tubes and should learn their capacity and their moods. In general, the size of the tube should correspond with the capacity of his machine. There are advantages in having tubes of different patterns, according to the purposes for which they are used. New tubes are of low vacuum. Those

that have a specially good focus (the target reddening at or near its center) should be reserved for *skiagraphy*, for radio-therapy does not require good definition.

Most new tubes possess a low vacuum and gradually become hardened through use and lose their usefulness for therapeutic purposes. By heating the tube equally a few minutes over a spirit lamp, the vacuum is quickly lowered and the tube rendered soft. After a tube has been



Fig. a.

treated in this manner, it requires but little use to reduce it to the same degree of hardness which it previously possessed. Eventually the tube becomes so hard that it is impossible to reduce it to the proper degree of softness.

Old tubes that have a tendency to become too low or too high while being used may very often be made to serve well by the employment of a single or multiple spark gap, or if they are persistently too high they may be baked in an oven.

When the shadows of the forearm or hand on the fluorescent screen are so black that the bone shows scarcely or not at all, the vacuum is too low for fluoroscopy (Fig. a), though a skia-

gram may be made with a very long exposure. When the bones of the hand or forearm appear very black on the screen, the vacuum is low (Fig.



Fig. b.



Fig. c.

b), and when these appear very light their outlines distinct, the vacuum is very high (Fig. c).

When the sparks pass around the tube from pole to pole, the vacuum is too high and the tube is in danger of being punctured (Fig. 1).

When the fluorescence in the tube is a rich green and is easily seen in a well-lighted room, the vacuum is usually low (Fig. 3), and when the fluorescence is less bright and its coloring yellowish green, the vacuum of the tube is high and has great penetrating power. Pictures of

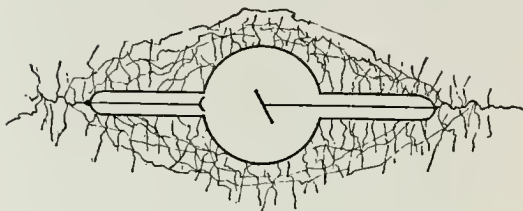


Fig. 1.

the hand lack contrast, the soft parts of the bones being easily penetrated (Fig. 2).

The color and brilliancy of tube fluorescence depend in part upon the volume of current employed, but also upon the age of the tube.

Tubes that have been much used lose the brightness of their fluorescence and in them the

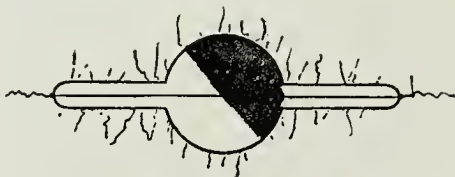


Fig. 3.

vacuum may still be low when the coloring is yellowish green (Fig. 4).

When the target of the tube quickly heats with a moderate current, the vacuum is low, but if without a water-cooling attachment the target remains cold with a considerable volume of cur-

rent passing through the tube, the vacuum is high.

If there is a blue light in the upper part of the tube above the target, the vacuum is low, and the greater the amount of this blue light, the lower the vacuum (Fig. 5).

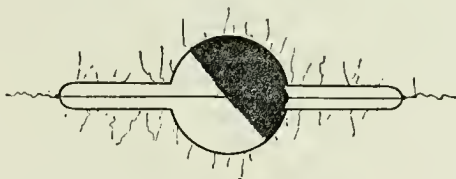


Fig. 2.

If the blue light passes between the cathode and the target, the vacuum is very low, and the tube must be cautiously regulated or it will be ruined.

If the blue light is replaced by a violet light, the tube should be set aside for several days to rest.

If the violet light passes between the cathode and the target, the tube is probably punctured.

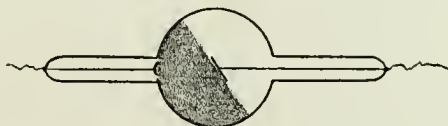


Fig. 4.

If sparks arc across between the poles, the tube has been punctured. In very old tubes this violet light may pass between the cathode and antecathode without the immediate usefulness of the tubes being necessarily impaired, though they have passed the stage where they may be considered good.

When the spark jumps between the lead wires, the vacuum is too high or the wires are too near together.

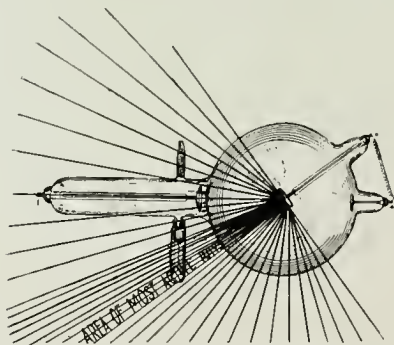
By the above mentioned signs the operator, as a rule, can determine the tension of his tube while it is in operation without exposing his



Fig. 5.

hand before a screen. In therapeutic work the practice is fairly general to use low vacuum for surface lesions and high vacuum for more deeply seated diseases.

The value of X-rays is no longer limited to the elementary study of the skeleton lesion, nor

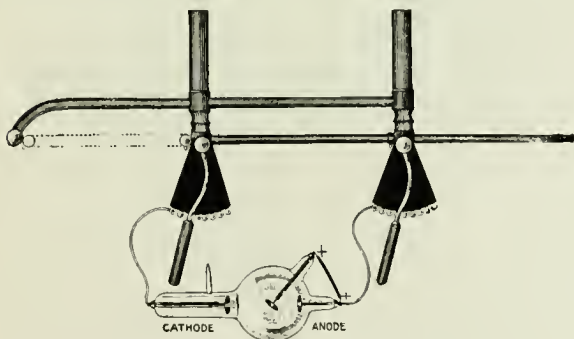


their use confined to a few experts, but are passing into the hands of the profession at large, where, with other instruments of precision, they properly belong.

To interpret the findings of an X-ray examination experience is needed, but this is true of

the stethoscope, the ophthalmoscope, cystoscope, and other instruments for examining the interior of the body.

One practiced in fluoroscopy can, with moderate illumination, discern on the screen details which another, whose eyes are not trained, cannot see at all, even with bright light. Fluoroscopy has its marked limitations. Many details may be found upon a plate which the screen entirely fails to show, and even fractures may be



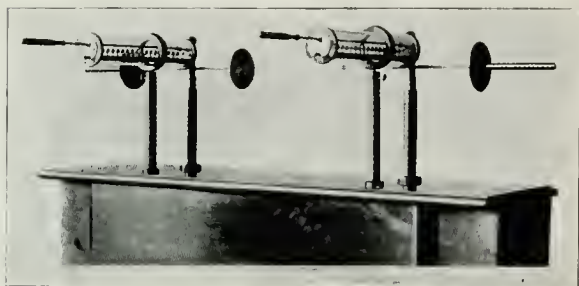
Pole Changer and Tube Regulator

overlooked if one limits his investigation to fluoroscopy.

In making a skiagram for locating foreign bodies, as well as fractures, it is well to make two or more pictures. (It must be remembered that the picture on the screen is a shadow of the part examined and that there are many sources from which errors may arrive.) This will enable one to locate the trouble exactly. It is even desirable that the operator develop his own plates.

The tube which allows the operator to see the shadow of his hand on a screen at a distance of fifteen to thirty feet cannot be depended upon

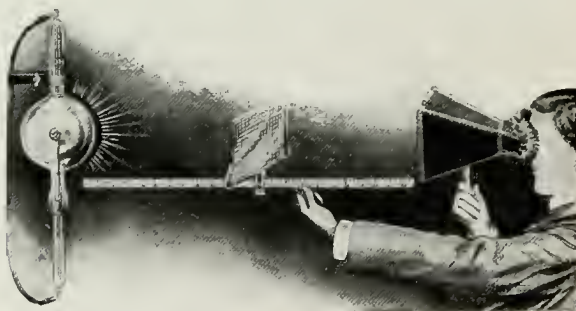
to make a good picture at a distance of two feet. When the vacuum is such as to give a satisfactory picture on the screen, it is higher than it ought to be for the best results with plate exposure of the same parts. In making a skia-



Tube Regulators Attached to Coil.

gram the length of exposure rather than the vacuum should be varied to allow for differences in density.

In skiagraphical work, it is desirable to have a tube with sharpness of definition or focusing powers. To make a test hold the fluoroscope



Examining Focus of Tube.

about two feet from the tube and hold a twenty mesh wire sieve between them. The nearer it is necessary to bring the screen to the fluoroscope, the poorer the focus, and the farther away the more accurate the focus. A tube now on the market has the anode mounted on a threaded stem which can be magnetically operated through the glass, moving it up or down or circumferentially with the surface of the tube to obtain an accurate focus.



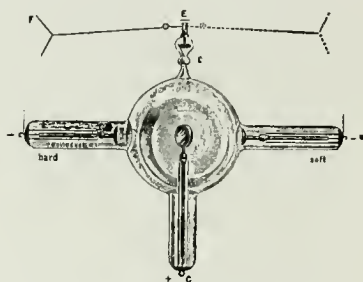
Adjusting Focus by Means of Magnet.

Another form of Roentgen tube is distinguished for its ability to furnish "hard" rays as well as "soft" ones, without any regulation of the vacuum. In this tube there are—as shown—two cathodes, A and B, of different form, by which "hard" rays may be produced by using the cathode A, and "soft" rays by using the cathode B. In either case, the anticathode C serves as anode.

Consequently one side of the tube, A, can be directly used for the penetration of the thicker parts of the body; the other side, B, however, for the thinner objects, and without making any

alterations. Further, the bilateral nature of the tube might prove of value with regard to therapeutic application of the X-rays.

In the field of internal medicine the X-rays are a valuable aid to our methods of examination. This is especially true in abscess of the lung, pleurisy with effusion, pneumo-thorax, pneumo-pyo-thorax, subphrenic abscess, pericardial effusions, hypertrophies and dilatation of the heart, displacement of the heart, calcareous deposits at the valves, atheromatous patches in the aorta and



X-Ray Tube with Both a Hard and Soft Section.

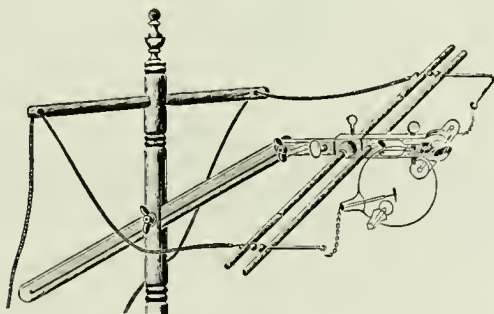
thoracic aneurism, whose presence could not be demonstrated by means of percussion or auscultation.

In making examinations of the chest for diagnosis of tuberculosis in its early stages, we must constantly bear in mind the normal conditions for comparison. We have to discriminate shadows of the chest, neck, shoulder, clavicle and ribs, and not consider the circumscribed shadows as due to pulmonary atelectasis. The rays frequently show the disease to be more extensive than has been mapped out by the usual methods of examination.

After many repeated observations, loss of mobility of the diaphragm seems to be the earliest indication of tubercular mischief in the lungs.

In children a simple bronchitis may be differentiated from a bronchial pneumonia or a croupous pneumonia, and enlarged bronchial glands may be frequently noticed.

The X-rays are also a valuable aid in locating foreign bodies in the lungs. These, unless removed, may cause a septic pneumonia or septicæmia.



Pole Changer.

Following the exhibition of bismuth, the patient's stomach may be outlined and the peristaltic action of the intestines may be studied.

In orthopædic work the X-rays are based upon a positive and scientific basis, and have become a necessity, because so much of its sphere has to do with diseases of the bones and this is what the X-rays are most prominently used for. In a swollen or extremely painful joint or limb the X-rays permit us to see the condition of the bones and thus prevent tubercular joints, etc., from being classed as rheumatism. This will prevent many stiff joints. A skiagraph will show the difference between osteoarthritis with



Compression and Fixation Apparatus for Use in Skiagraphy.

enlargement of the bones from rheumatoid arthritis, where the disease is due to the cartilaginous portion, and where the bone frequently diminishes in size as the disease advances.

An interesting case occurred in the author's experience. A boy seventeen years old who had failed to grow even a fraction of an inch in height since he was eleven years old had, on physical examination been declared by eminent authority to have reached his full height and that further efforts in that direction would be without avail. The boy was examined by means of the fluoroscope, which showed the epiphyseal and diaphyseal cartilages had not yet become os-

sified. Under electrical treatment and massage the boy gained nearly three inches in a year and is still growing.

The X-rays may be extremely valuable in helping us to clear up the diagnosis of obscure nervous diseases, as a callous formation might simulate a number of pathological conditions.

One of the greatest diagnostic achievements and the most exacting work of the X-rays is the search for renal, urethral and vesical calculi in the living body, making an exploratory operation unnecessary. Gall stones may also be photographed when of phosphatic formation.

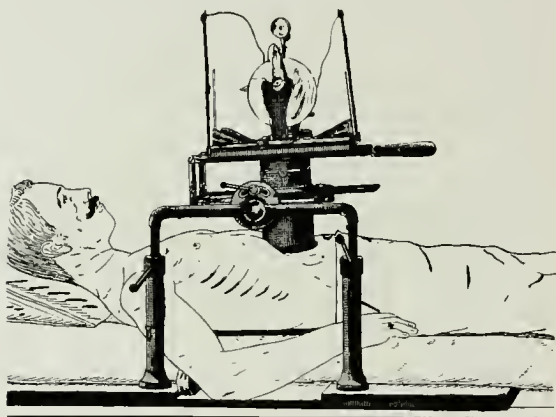
The compression method as first adopted in Germany is a device by which pressure is exerted by a directing tube through which the rays are aimed at an exact target. This not only enables you to reduce the thickness by compressing the soft parts, but also enables one to push aside the obstructing part, enabling the rays to better reach the kidneys and bringing the objects sought nearer the photographic plate. It also serves to fix the parts on the table. This apparatus has the advantage of permitting us to use small plates, which are comparatively inexpensive. A high degree of sharpness also is obtained, as voluntary and involuntary movements are out of the question. The tube is always the same distance from the body.

The principal advantage of the compression tubes is that it permits radiographs of the head, shoulder, hip-joint, lumbar vertebra, etc., to be taken, which compare favorably with dissected bones.

This apparatus with the use of a penetrometer which has been standardized by the German government enables the operator to duplicate results almost exactly, as he can accurately determine the penetrating power of his tube.

The penetrometer consists of a small fluoroscopic screen arranged in an oval-shaped box with six circular platinum disks, set in a lead plate. Each of these platinum disks is of a different density, hence determines the penetrating qualities of the rays.

Since the introduction of the X-ray and its wonderful power to penetrate opaque substances, its efficacy has been demonstrated in the treat-



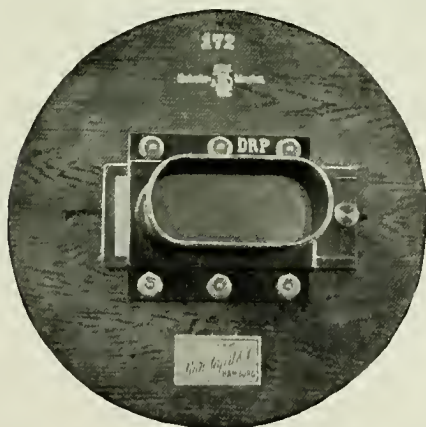
Compression Apparatus in Use.

ment of certain affections which have hitherto eluded both the physician and the surgeon.

The list of diseases in which the rays have been used with varying success at the present time includes epithelioma, carcinoma, sarcoma, psoriasis, eczema, hypertrichosis, sycosis, nævus, lichen planus, pruritis, dermatitis of an itching nature, keratosis, acne and keloid, leukæmia, pseudo-leukæmia, pain in malignant growths and tubercular joints, superficial parasitic diseases and neuralgias, and rheumatism of a subacute na-

ture in the joints. The X-ray is one of the most certain, definite and effective remedies for the relief of pain, and the anodyne effects of the raying are not produced by local anæsthesia, but change the disordered sensations into orderly and normal ones.

One operator has found that deeply penetrating rays have arrested the progress of degenera-



Walter's International Standard Penetrometer.

tive changes in tabetic patients, possibly causing an obliteration of the cells of low vitality and stimulating a more healthy action and increased resistance in the normal tissues. At any rate, he succeeded in arresting the lightning pain, reducing the ataxic symptoms, causing a return of the knee jerk and an improvement in the general condition.

No one should undertake the use of this agent who is not reasonably familiar with its physical, physiological and therapeutic properties. In the

hands of a safe and reliable operator it is capable of great good, while in the hands of one ignorant of its properties it may do much harm.

The technique of X-ray therapy is not a science; it is an art, and cannot be learned from books. It is the product of experience, and experience only teaches us the demands and particular needs of each individual case.

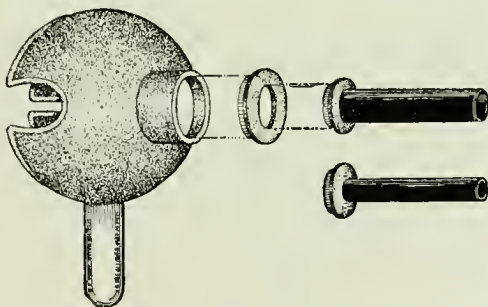
The X-rays have a decided inhibitory influence on the majority of diseases. In carcinoma of the intestines, where life has been threatened with intestinal obstruction, the symptoms have been relieved, tumor reduced inside and life prolonged for variable periods. On the other hand, pain and suffering have been alleviated in the majority of cases. Rapidly progressing malignant and inoperable tumors have been indefinitely held in check and those that have recurred after complete disappearance have in some instances again responded to further treatment.

Under the action of the X-rays the hair follicles and glands become functionally inactive and at the same time are impaired by the cutting off of the nutrition furnished by the normal blood supply. Characteristic contractions of protoplasmic structures are produced. The arterials contracting deprive the skin of the usual blood supply. Therefore, when treating the neck and the face, the hair and the eyes should always be protected by a layer of thin lead foil or rubber cloth. The operator must be particularly careful to protect any abraded tissues he may have about his hands, as they form a fruitful culture field for the infections with chronic malignant diseases.

If, for any reason, a diabetic patient is exposed to X-ray treatment, it must be remembered that the reaction of the X-rays is out of proportion

to what takes place in other patients, on account of the weakened condition of the tissues.

A large number of theories are advanced as to how the X-rays exert their curative properties, but it yet remains for the investigators to reveal the facts, and when once decided what X-ray does to living tissue, there still remains to decide how this affects the cancerous growth, and this latter decision can never be reached until we know what cancer is. The most reasonable theory as to its mode of action is probably that a



X-Ray Shield.

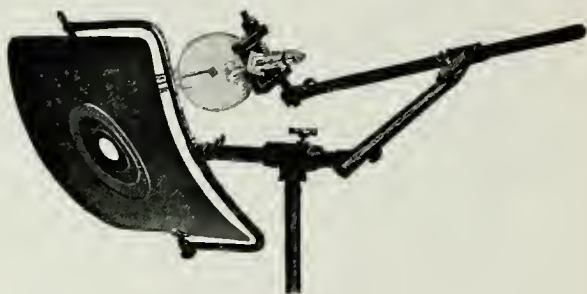
mild leucocytosis is established, with a consequent ability of the living tissue to cope with and conquer cancerous cell proliferation.

When an increased number of leucocytes is found in those cases undergoing X-ray treatments, an improvement is usually noticed, whereas when they become less in number than when the treatment was begun, then a continuation is useless. A combination of X-ray treatments and internal medication gives the best results, the internal treatment consisting in securing the proper degree of alkalinity in the system, the administration of either arsenic or thyroid extract, or both.

In the treatment of Hodgkin's disease and other

ailments, where it is necessary to X-ray the entire body, the patient may be exposed to the rays at the proper distance and intensity daily from three-quarters of an hour to an hour without suffering harm; on the contrary, gaining in health all the time.

The X-rays are apparently a valuable aid in the treatment of pulmonary tuberculosis, though by no means a curative measure. Hemorrhagic cases have made surprisingly quick recoveries, wonderful improvement taking place in eight to



X-Ray Shield.

twelve weeks. Fibroid cases are very slow healing and it is doubtful if X-ray exposures have any effect. The temperature is frequently relieved, but beyond this there is no notable change.

In the treatment of cancers, it may be put forward as a broad general statement that the earlier the disease is discovered and X-radiation employed, the more confident we may be of success, for two reasons:

First, because the new growth is cut down and restricted more easily than when more matured.

Second, because the cancerous particles have not had time to migrate from their initial foci

and spread the disease widely in districts which may be inaccessible. Every case of cancer should be treated with the X-ray at once, before surgical operation, and every case operated upon should be treated as soon as possible to prevent a return of the disease.

The universally disastrous results or sequences of operative procedure are due to the failure of reaching all the infected area. If the tumor is well advanced, X-radiation may produce retrogression of the growth, but even though this is so, there still remains a vast mass of diseased tissue, which it is desirable to get rid of and which should be removed by the knife.

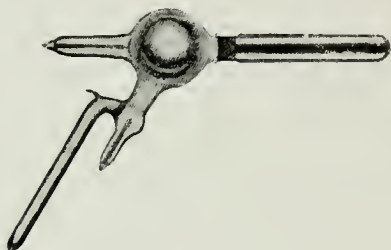
To avoid an overexposure one had best proceed in a methodical manner, keeping a memorandum of both the distance of the tube from the part exposed and the time of the exposure. One may begin with a distance of ten inches for a ten minutes' exposure, diminishing one inch for each treatment until the distance is five inches from the exposed area. The time may be gradually increased. The object is to create a mild dermatitis, taking care not to induce such an irritation as would result in the destruction of the skin or subcutaneous tissue.

This dermatitis is not unlike the tanning of the skin when exposed to the rays of the sun. Several treatments may be given before this bronzing or tanning effect is appreciated. As a rule no therapeutic effects are noticed until it is established. The number and lengths of treatment it has taken to produce this dermatitis will be an excellent criterion of the patient's susceptibility. The operator will get the best results by regulating the length and frequency of exposure so that the bronzing may continue and become more pronounced without producing an actual burn.

Desquamation usually follows this dermatitis,

and the patient has a slight burning after the treatment, which usually wears off in twenty-four hours. Should the exposure be too frequent and long, an actual and aggravated burn will occur, penetrating the tissues beneath the skin, and in some instances be followed by large sloughs.

It seems that individuals who are sensitive to the sun's rays are likewise sensitive to the X-rays. Idiosyncrasy, here as elsewhere, plays its part.



Jacket X-Ray Tube for Treating Cavities.

It is necessary that the operator take some precaution to protect his hands.

Flexible rubber cloth opaque to the rays can be made into aprons or jackets, vests or gloves, and thus offer protection to both patient and operator.

When treating an extensive affection of the face, as acne, particular pains should be taken to completely cover the hair to the margin as well as the eyebrows, thereby avoiding accidental alopecia.

In treating epithelial growths of the face protect the parts not involved. It is always wise to screen the trunk when the face is being treated, and vice versa.

As the axillary glands are usually involved in cancer of the breast, it is usually well to give one

radiation from the front and one radiation from the side at each treatment.

As it is impossible to say how extensive a cancer infiltration has become, the greater the area treated the greater the chances are of safety to the patient. If only the tumor itself is treated it frequently happens that the lymphatics draining the diseased tissue become larger, though the treated area becomes smaller. The futility of a shield in such a case is obvious. We want to reach all the carcinoma cells if we can, and the so-called shield does not shield the patient, but the carcinoma cells.

Of what use to treat a local sore and neglect the outlying section, which in its turn is certain to carry off the patient. In short, it is important to cause the radiations to reach the tumor and its lymphatics from as many directions as possible.

When an open ulcer exists, there is a danger of secondary infection in the treatment itself, for if the Crook's tube be examined, especially if it was one of high vacuum, it will be found coated with dust and dirt particles. These are positive particles corresponding to a similar shower of negative particles, which are projected into the ulcer and which may lead to the secondary infection alluded to. For this reason it is well to cover an open ulcer with a layer of absorbent cotton during the treatment.

Too vigorous an application of the X-rays, by breaking down diseased tissue and throwing it upon the lymphatic circulation in large quantities, may cause an auto-intoxication which, if persisted in, may cause speedy death. There is also the possible danger that in the breaking down some of the living tumor cells may be carried to remote parts of the body, causing metastasis.

We are not justified to use the destructive power of the X-ray to cause necrosis in the man-

ner of the old-fashioned cancer pastes, etc. The choice between such an X-ray burn and a cancer is terrible. We must always remember that cancers may arise from X-ray burns, and that a number of X-ray workers are at present so afflicted.

Treatments are usually given three to four times weekly, for ten minutes from a static machine or six to eight minutes when using a coil, at a distance of nine inches, with an X-radiation intensity affording a given picture of the lower end of the radius and ulna at two feet distance, thus producing a fair dermatitis in from two to four weeks, and then continuing in the same manner. An unexpected burn of severity may be avoided by discontinuing treatment on the appearance of a dermatitis.

Discontinuance of the X-ray treatment does not always mean a cessation of the curative process. The effects of radiation are frequently prolonged for several months after the last exposure, showing that the X-rays have a cumulative action.

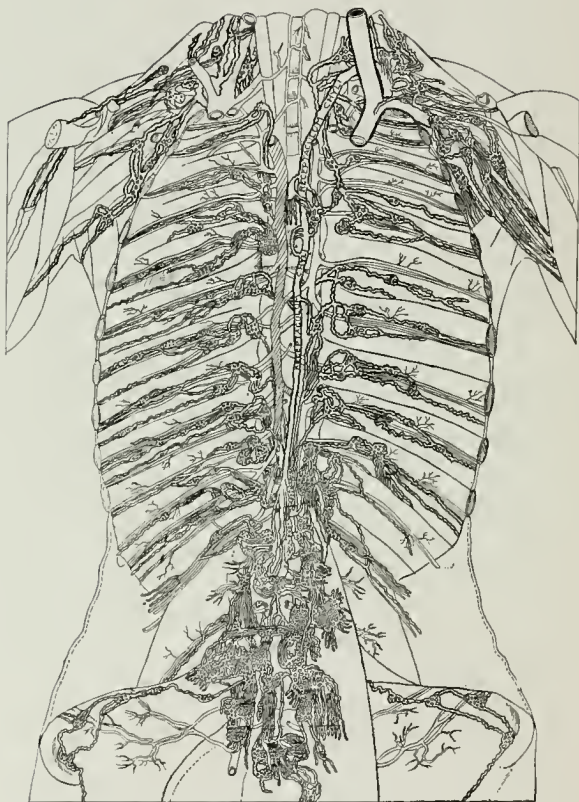
VIBRATORY STIMULATION.

Viewed from one point, all disorders of whatever sort are due to defective nutrition. It is the first step in every abnormal process, or, indeed, constitutes the whole of it. The integrity of an organ, as well as the maintenance of its functions, depends on a suitable supply of nutriment, both in quality and quantity. If it were possible for us at all times to know what is at fault, and to be at hand when the nutritive processes first begin to depart from physiological paths, and to have at our demand and apply means to set these processes right, both our pathology and our therapeutics would reach their ideal stage. But, as a rule, the abnormal goes on and we often recognize it only at a later stage, and here it is that we begin our process of repair, if repair is possible.

The deeper the insight one acquires of the nature of physiological action in living tissues and of the causes and influences that tend to divert that action beyond the limits of health, the more simple and rational will be the therapeutic means employed to remove the causes and check the morbid tendencies.

Action brings waste, and time and rest are needed for the reconstruction of the wasted substance. Often, through disregard of physiological laws, repair takes place slowly and laboriously, and at times even a cessation of efforts at repair may occur.

The nutrition of the body is decided by the quality of circulation in the minute lymph chan-



Receptaculum Chyli; Thoracic and Abdominal Lymphatics.

Study of this chart shows why the deep cervical glands on the left side are always more or less involved in auto-intoxication from intestinal disorders.

nels outside of the capillary walls. It is through these channels that the stream of plasma from the blood reaches the tissues, and it is here that the destructive germ or poison is seized upon by the phagocyte and torn apart, to be digested and the detritus robbed of its infecting quality and discharged into the blood, to be finally eliminated. The minute size, situation and function of these channels render them peculiarly susceptible and liable to obstruction. Impurities which readily circulate through the heart and arteries without inconvenience frequently lodge in these channels and obstruct them, greatly to the concern of the organs or tissues affected. Along the larger lymph vessels we have numerous lymph glands, which act like catch basins in the sewerage system of our city. The waste that is poured into the pipes at our houses does not flow out into the main sewer of the street at once, but passes through a series of catch basins, where the heavy material settles to the bottom and the lighter fluid flows on into the sewer. The most numerous of these glands are found along the great lymph vessels of the abdomen, neck, mesentery, axilla, groin and popliteal space. These so-called reservoirs drain the tissues adjacent to them, and their activity is an important process in absorption and nutrition, being more intimately connected with tissue metabolism than the blood. If these glands become overloaded with waste, their activity is markedly interfered with and auto-infection takes place, instances of which we find in such diseases as syphilis, scrofula, tuberculosis, etc., where the glands become enlarged and indurated. The more profoundly they are enlarged or involved, the more profound is the systemic infection. The whole problem of elimination of waste depends



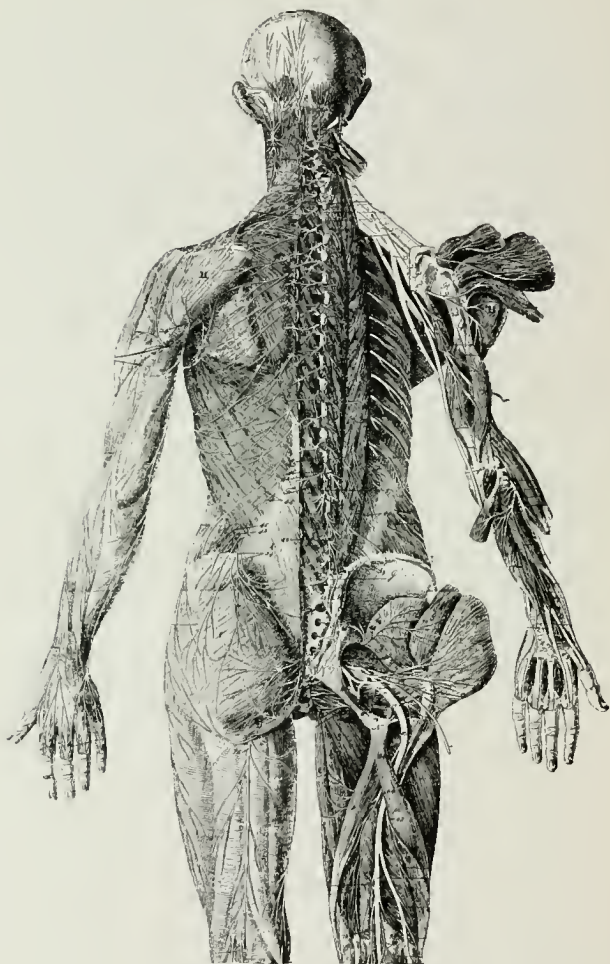
Glands and Lymphatics of Cervical Region—Lymphatics on
Posterior of Sternum.

upon the efficient functionation of this system. The detritus and broken-down products of waste must be removed from the tissues and lymphatics and discharged into the circulation *en route* to the organs of elimination.

When the roadway over which the poisonous products must pass is clogged, drug stimulation of the heart, liver, kidney and spleen frequently does not meet with the success we desire and nature must be supplemented and complemented in another way.

When we consider the cause and seek a cure for these conditions, we can find nothing more logical and helpful than passive motion as represented by scientific massage.

Massage is the most direct, agreeable and certain of remedies, as it restores nutrition, sensation and power. One of the most striking effects of this treatment is the prompt and agreeable manner in which it relieves pain. It not only suppresses the consciousness of pain after the manner of opiates and other nerve sedatives, but it abolishes it by restoring to a normal, harmonious state the disorderly conditions which are responsible for its existence; strengthens the organs involved, thus preventing a return of the difficulty; re-establishes the normal currents in the blood vessels and intravascular fluids, and thus initiates a new and healthful condition. Massage is peculiarly adapted to promote and establish physiological drainage for local stagnation, as it employs the same means which nature uses in health, with the additional value of intensifying them, and making them operative in the regions where they are most needed. It progressively rends asunder adhesions which may exist in the tissues, and causes the absorption



Distribution of Deep and Cutaneous Nerves on Back of Trunk.

of effused material and causes an increased nutrition of the body tissues.

There is no hypnotic so conducive to restful sleep as an equalized nerve force; no stimulation so effective as a perfect circulation; no reaction so natural as that which follows physiological action.

The nervous structure is very sensitive to any morbid action in its nutritive supply, and is everywhere supplied with large vessels which freely anastomose and give evidence of the need of this tissue for an abundant stream of nutrient fluid,



Fig. 1



Fig. 2.

in order that its activities may not flag. If for any reason the expenditure of energy, due to overwork, whatever its nature, in any one part of the body becomes excessive, we find an excess of blood transferred to the nutrient centers of that organ in the spinal cord to give support to the activities constantly taking place. This disturbed equilibrium in the circulation of the nervous system is apt to perpetuate itself in various functional disorders, which can be cured only by removing the cause.

Fig. 2 shows a condition occasionally brought on by prolonged contracture of the spinal muscles. This condition interferes in a marked degree with the function of the spinal nerves and

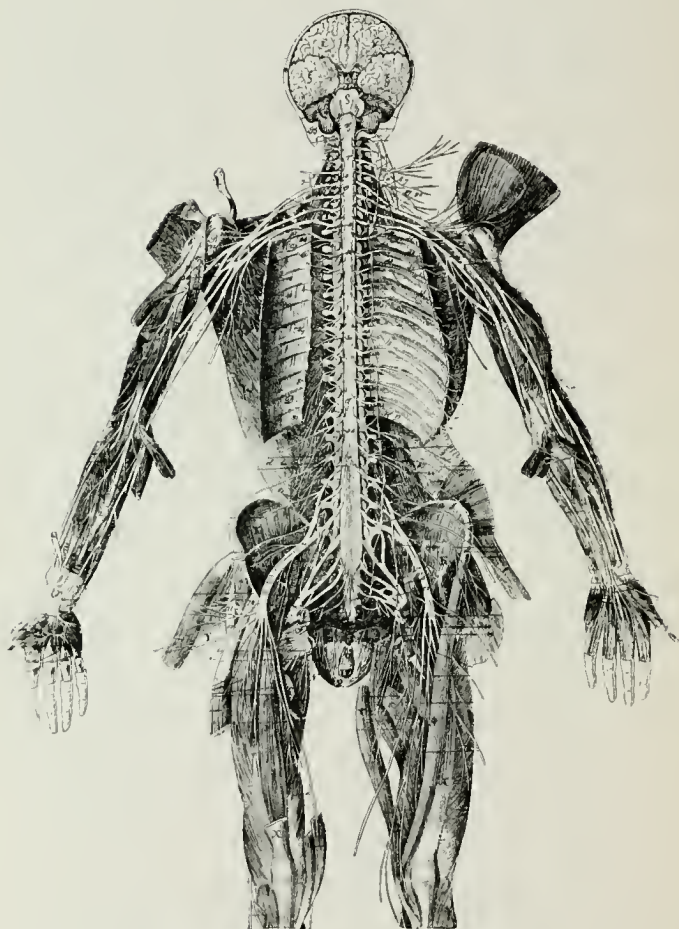


Diagram of Spinal Nerves and Plexuses.

disease of the organ to which they lead is inevitable.

The human body has been likened to a community in which a variety of industries are carried on, each in a different way, but all conducted to the common welfare and all controlled by its official head and its subordinates, the various organs of the body being connected with the center of operations, the brain, by means of the nerves, which are like so many electric wires running to and from the seat of government. If any of these wires become crossed, or if the current is shut off in any way, there will be trouble manifested in that particular part of the anatomy dependent upon that particular wire. As the various parts are dependent upon one another, an injury to one means an injury to all.

Carrying the comparison a little farther, the spinal cord in man resembles the trunk line of a telephone system, the ganglions acting as the substations, from where lines run to the various departments or organs.

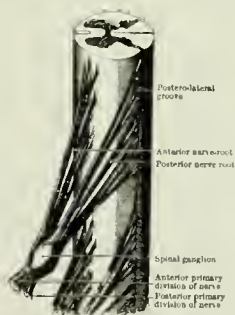
When the telephone at our office or residence fails to work properly, or the sounds transmitted become very faint, the trouble usually lies in the instrument itself, or somewhere between it and the switchboard at the local office. It is very much the same with our nervous system, and the fault rarely lies farther away than the local centers in the spine.

All the functions and organs of the body are controlled by certain nerves, and almost every nerve in the body may be looked upon as influencing a certain set of blood vessels, thus controlling the nutrition in this vascular area regardless of the heart's action.

It is well known that a chronic irritation of the periphery or in a distinct viscus is usually communicated to the nerve center in the spine which

controls its nutrition, and extreme sensitiveness at this point is frequently disclosed on deep pressure.

The muscles overlying this reflexly affected spinal nerve center will generally be found contracted, and even atrophied, if the condition is of long standing, because the nerves supplying the contracted muscles originate in the same area in the cord that is reflexly irritated from the irritated viscera, and consequently participate in the irritation to which it gives rise.



Roots and Origin of the Seventh Dorsal Nerve.

It is plain to see that the centers which control nutrition and excretion are of vast importance in regulating the general welfare of the organism.

If a muscle is contracted and tightened down on one or more nerves trouble is sure to follow. If the nerve interfered with happens to be a sensory nerve paralysis may ensue; if a sympathetic nerve the nutrition is cut off.

Interference with the circulation and nerve current is often removed by the free movement and manipulation of the arms and legs, which frees and softens up the muscles and releases the obstructed circulation and nerve current and

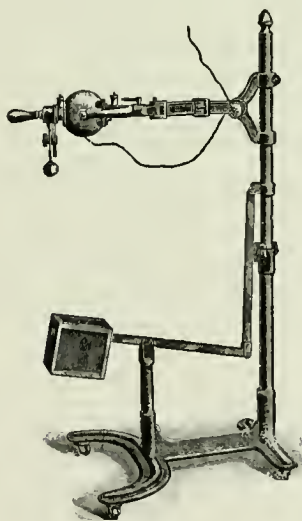
allows nature to restore normal conditions. It is often found that contracted muscles are drawing in the ribs and exerting an undue pressure upon some organ of the body. This condition can frequently be relieved by having the patient hold his arm high above the head while the operator presses upon the spine just below the shoulder blade. This treatment stretches the contracted chest muscles and releases the ribs. Any change in the blood supply to the stomach and intestines has its direct effect on the nutrition of the body, influencing both digestion and absorption, and also on the excretion through the kidneys.

The nervous system is so constructed that it can be affected only by vibrations. Vibrations of from sixteen per second to forty thousand per second affect the auditory nerve; vibrations between 497 billions and 728 billions affect the optic nerve. What becomes of all the vibrations between 40,000 and 497 billions we do not know.

It has been estimated that it would take a man with about seventy senses to appreciate the vibrations found between these two numbers.

Recent scientific investigations inform us that all the ponderous forces of this world are a series of vibrations. Of these light, heat and the influence of electricity and magnetism are the most common. The actions taking place within the body by chemical combinations produce vibratory effects which are evidenced by the production of rates comparable to those which are characteristic of light and heat. An experiment performed by Prof. Elmer Gates goes to show that the body is practically an electric battery. He arranged a room lined throughout with sheets of lead, walls, ceiling and floor. The lead was connected with the earth by electrical conductors, passing through a galvanometer sufficiently sen-

sitive to measure the amount of electricity emitted by any person in this room. It was found that every motion of muscle, nerve tissue, mental activity, etc., produces enough electricity to disturb this delicate instrument. This sensitive apparatus of course only measures electric activity, but it is probable that some way or



Chattanooga Vibrator.

means may be devised to measure the other unknown forces or vibrations acting in the body at the same time.

Investigations show that conditions similar to the "n" rays are emitted by the human body and that the effect produced upon a sensitive screen placed at a little distance is proportional to the physiological activity of the part, being greatest in the case of nerve and muscle. By using a small screen and marking the variation in

luminosity exhibited, it is found to be possible to map out the heart and to trace the course of nerves beneath the skin. That the phenomena was not due to heat simply was shown by interposing screens of aluminum or glass, which did not affect the result, nor could the rays be supposed to have been previously absorbed from some external source, since the manifestations were obtainable equally well after the part of the body under observation had been kept in darkness for nine hours.

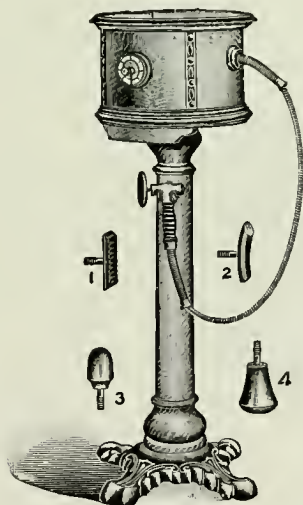
The study of the various frequencies of vibration and the character of their vibration is only in its infancy, but enough has been shown to lead us to believe that there is in each individual a varying rhythm and rate of frequency associated in the performance of the various functions, which while relatively the same in the species are essentially different in each individual. (These variations probably explain many individual idiosyncrasies.)

The curative action of the vibratory influence depends upon the character of the vibration and its adaptation to the effect demanded. The therapeutic influence of the various forms of electricity probably depends upon the voltage and the difference in the rate of vibration.

It has also been discovered that the cilio-spinal nerves may be stimulated and soreness relieved mechanically by the hand or finger when pressure with light vibratory motion is brought to bear on tender spots. The osteopath has utilized this measure with a marked degree of success.

Vibrations produced by an oscillatory movement or a succession of rapid individual efforts of the operator's hands are a powerful stimulant to the tissues. The method of giving manual vibration is produced in the following manner. The palm of the hand or fingers must be placed

firmly upon the part to be treated, the arm being held straight and the fine trembling or vibrating movements communicated to the hand by the muscles of the upper part of the arm. This treatment has a stimulating and strengthening effect upon the nerves and acts strongly upon the venous circulation, as well as upon the



Betz Vibrator.

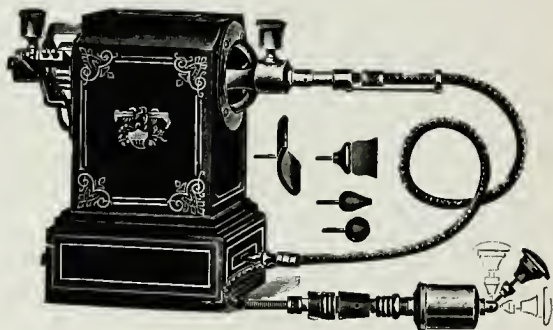
lymphatics. When giving a vibratory treatment the pressure exerted should not be greater than the weight of the hand.

By stimulation we urge and assist the nerves to more effectually functionate and fulfill their physiological mission. In thus co-operating with and assisting nature we help to bring about a cure. Vibratory stimulation thus places at our disposal a means whereby the center in the cord may be reached, thus maintaining a balance

of circulation between the spinal cord and the organs of the body.

Stimulation of the spinal cord brings about that sensation of well-being conferred by nothing but good health. The man whose spinal cord is in perfect health is rare, for he possesses unfailing energy and cheerfulness and knows not what it is to be depressed.

The advent of the electric vibrator, of which there are a number on the market, gives us a means far superior to manual manipulation.



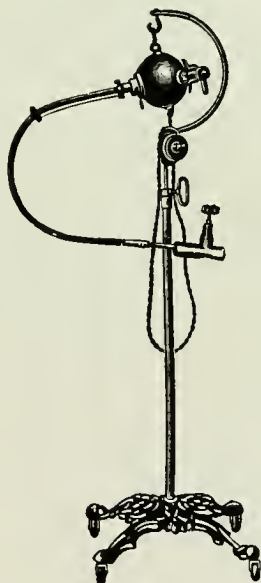
Victor Vibrator.

The vibrator in the hands of a skilful operator will replace a masseur in many instances, for with the brush attachment we are able to treat sensitive areas with greater comfort and with final relief to patient, than by manipulation of the most skillful masseur. It must not be understood, however, that vibration can entirely replace massage.

As stroking by hand is very useful in producing quieting and sedative effects, so the impulse produced by the vibrator, with a soft rubber applicator, just touching the patient, is very useful in relieving certain forms of headaches and in affording relief from insomnia. This motion

should always be performed in one direction only, not an up and down or a to and fro motion. Lightness and gentleness are the words best describing this treatment.

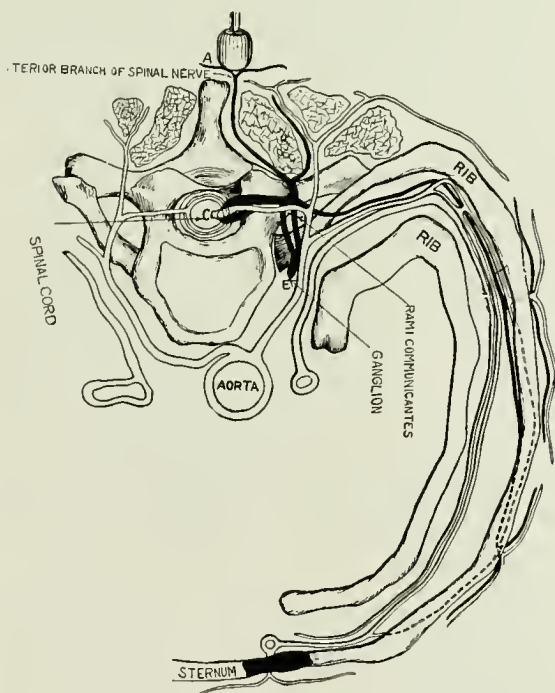
To be successful in the use of the vibrator it is absolutely essential to know the nerve connections of the various organs and tissues.



Bihlmaier Vibrator.

Having decided what tissue or organ is affected, we determine the vaso-motor area in the spinal column which controls the circulation to the affected organ and apply stimulation to that area. In cases difficult of diagnosis we are frequently aided by the muscular contracture in the spinal muscles. Stimulation of the spinal centers causes the muscles to relax and become soft, in-

creases metabolism and relieves pain. Pressure on a nerve causes it to vibrate or increase its natural impulse. An irritated nerve fiber responds to stimulation more quickly than the unaffected nerve fibers.

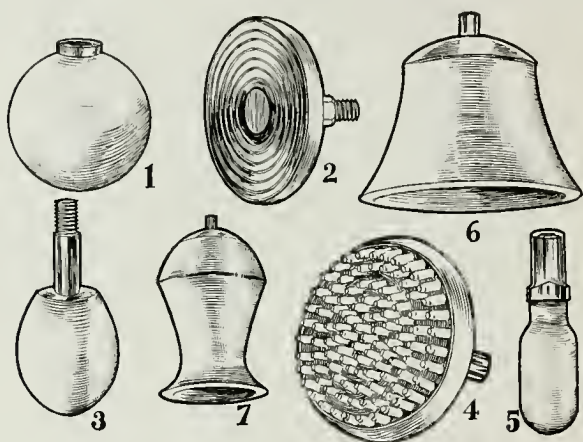


Application of Vibrator to Spinal Nerve.

Vibration with light pressure along the course of the nerve will stimulate the organ supplied by that nerve. On the other hand a steady deep pressure desensitizes or deadens the sensation. The points at which the pressure is more frequently employed are the motor points lying

near the surface where the principal nerves are easily reached. The spinal nerves are treated by means of the vibrator placed on either side of the spinal column, exerting a pressure at points on a line within the space of the vertebræ. The spinal nerves control directly or reflexly the nutrition of the diseased viscera.

In treating the spine look for tender hot or cold spots or a knotted condition of the muscles.



Applicators for Vibratory Massage and Stimulation.

In the treatment of digestive disorders have the patient in a perfectly relaxed condition and apply vibration to spine and abdominal viscera, and also deep and firm vibration to the lower part of the neck on either side of the larynx. This stimulates the pneumogastric nerve which largely influences the organs of digestion.

Interference with the circulation to and from the head often manifests itself in the shape of deafness, impaired sight, catarrh and other disorders as dizziness, headache, etc. This inter-

ference is frequently brought on by pressure or contraction of the muscles of the neck. Deep vibratory stimulation usually assists in the restoration of normal conditions. Removal through stimulation of the lymphatics and their glands may cause the disappearance of many forms of tumors, enlargements, exudates and other products of inflammation; also the relief of varicosities and the dispersion of many varieties of cutaneous eruptions.

Elimination may be accelerated through stimulation applied to the nerves controlling the lymphatic glands and other large excretory organs, of which the liver, kidney and spleen are the most important.

In the treatment of chronic cough and the bacillary stage of tuberculosis, vibratory stimulation is a valuable remedy, and frequently gives immediate results where drugs absolutely fail to give any relief whatever.

Physiology teaches us that stimulation of the intercostal nerves causes reflex constriction of the pulmonary vessels. The intercostal nerves are all connected directly with the sympathetic system, by *rami communicantes*, and the sympathetic vaso-dilator and vaso-constrictor fibers of the system are situated all along the thoracic spinal region. Luxation of ribs and flattened thorax (dropped ribs) set up irritation in the intercostal nerves, leading to a constriction of the pulmonary vessels.

The general or local anæmia of lung tissue thus produced weakens and devitalizes the tissues, affording a favorable foothold to the pathogenic bacteria, it being a well-known fact that bacteria cannot grow in healthy tissue.

The vaso-motor spinal area for the lungs (2d to 7th dorsal), and particularly the region of the 2d, 3d and 4th thoracic ganglia, are most apt to

suffer from lesions in disease of the lungs. Contracture of spinal muscles, brought about by an acute bronchitis, thus frequently proves the starting point of pulmonary tuberculosis.

The starting point of tuberculosis is usually located in the apices of the lungs, opposite the first and second intercostal spaces, below the outer third of the clavicle, in close relation to the ribs apparently most often luxated in this disease.

In applying treatment remove all obstruction to the normal nerve and circulatory activities. Build up the vaso-motor activities; relax the spinal muscles and deep tissues by vibratory stimulation. Raise the clavicles and ribs to allow the greatest area of expansion, in this way increasing the blood supply to the lungs.

The cough may also be relieved by toning up the pneumogastric, phrenic and cervical sympathetic nerves. This is done by treatment along the trachea and anterior thorax.

In the treatment of the various disorders of the human body, we find that vibratory stimulation or inhibition applied to the nerves and centers of the organs or tissues involved is a great aid in connection with other treatments; in fact, seems to be the only treatment necessary in some otherwise very stubborn cases. As the electric vibrator is not an absolute necessity, we find vibratory stimulation a valuable aid in our bedside practice, where it may be applied by means of the fingers or the palm of the hand.

An acute attack of lumbago or backache may frequently be relieved by means of vibratory oscillations, applied to the back and abdomen by means of the palm of the hand.

In appendicitis, after the bowels have been thoroughly emptied, vibratory stimulation of the entire spine, and especially the painful spots, seems in some cases to relieve and modify the pain in

the abdomen to a marked degree and greatly hastens recovery.

In fatigued, tired and painful conditions of the arms, vibratory pressure exerted on the nerves in the supra-clavicular fossa frequently brings instant relief.

To inhibit a nerve, deep pressure and not vibration is the necessary measure. Inhibition is not used to the same extent as stimulation, but is found very useful in a number of disorders. The most favorable for mechanical inhibition are dysentery, diarrhœa, colic, etc. The principal trouble here seems to be over the splanchnic nerve. By pressing your knee against the patient's spine just below the last rib, at the same time bending the patient backward, brings pressure to bear upon the nerves, desensitizing them and shutting off nature's current. In infants or children, laying a pillow beneath the center of the child's back will bring about the same result. This frequently affords instant relief, and often one simple treatment will effect an entire cure.

When desirable to inhibit the phrenic nerve (as in hiccough), it may be done in the following manner: Place the fingers of each hand upon the transverse process of the third, fourth and fifth cervical. Press the finger forward and down in front of the transverse processes and press upon the phrenic nerve which controls the diaphragm.

The following table may be used with advantage in applying vibration or electrical treatments at the spine:

C., Cervical. L., Lumbar. D., Dorsal. S., Sacral.

Arteries.	Circulation influenced by stimulation or inhibition at.	1	to	6	C.
Brain.....	Blood supply, controlled.....	1	to	6	C.
	Cervical brain	1	C.	to	5 D.
	Abdominal brain....	7	C.	to	3 L.
	Pelvic brain.....	9	D.	to	5 L.
Face.....	Vaso dilators.....	2	to	5	D.
	Vaso constrictors	1	to	6	D.
Eye.....	Recti of eyeball.....	2	to	3	D.
	Ciliary centre.....	2	to	3	D.
	Vaso constrictors of retina..	2	to	3	D.
	Vaso dilator of ant. part of eye	1	to	2	D.
Œsophagus....	Treat between.....	8	and	9	D.
Nose.....	Catarrh.....	1	to	6	C.
Nutrition centre.....	.....	6	D.	to	5 S.
Larynx.....	.....	1	to	3	C.
Heart.....	Rythm.	3	to	4	C.
	Vaso motor of valves.....	1	to	3	D.
	.....	2	to	4	D.
Lungs.....	.....	1	to	9	D.
Diaphragm....	Hiccough.....inhibit	3	4	5	C.
	Treat at.....	11	and	12	D.
Liver.....	And gall bladder.....	6	to	12	D.
	Torpid.....on rt. side	and	6	to	7 C.
Stomach.....	Cardiac orifice.....	6	to	7	D.
	Pyloric orifice.....	4	to	5	D.
	“ “ rt. side.....	8	to	9	D.
Intestines.....	Duodenum	1	to	5	D.
	Jejunum.....	5	to	11	D.
	Ileum.....	1	to	4	L.
	Caecum.....	1	to	4	L.
	Colon.....	5	to	11	D.
	Induce peristalsis, stimulate.	9	to	12	D.
	Diarrhoea, strong inhibition..	11	to	12	D.
	Defecation centre.....	2	to	5	L.
Receptaculum chyli.....	To dilate.....stimulate	5	to	12	D.
Kidneys.....	.....	6	D.	to	2 L.
Urethra.....	Bladder.....	4	to	5	L.
Testes.....	Vas. def. and seminal vesicle.	10	D.	to	5 L.
Penis.....	Spermatic centre.....	2	to	2	L.
	Erection centre.....	2	to	2	L.
Prostate gland.....	.....	5	L.	to	3 S.
Ovaries.....	Circulation controlled.....	9	to	11	D.
	Pain	10	to	10	D.
Uterus .....	.....	1	L.	to	3 S.
	Cervix.....	9	to	9	D.
	Os	1	to	5	S.
	In contractions.....	1 L.	10	to	12 D.
	Vaso motor.....	12 D.	2	to	5 L.
	Amenorrhœa.....stimulate	2	to	5	L.
	Dysmenorrhœa.....Inhibit	2	to	5	L.
	Morning sickness.....stimulate	4	to	5	D.
Vagina.....	To relax	4	to	4	S.
	Vaso motors.....	12	D.	2	5 L.
Paralysis.....	Upper extremity	5	C.	to	1 D.
	Vaso motors.....	5	to	6	D.
	Lower extremity.....	1	to	6	C.
	Vaso motors.....	from 2 D. down.			

LIGHT.

It has long been known that impure air and darkness breed disease, but it is only recently that we have learned why and how light exercises its power. Investigation has demonstrated that it is not warmth but light which enables more complicated tissues to be formed from simple ones. The importance of light on living organisms, plants and animals alike, is well known to all. Lack of light causes disease and *vice versa*. We find the least illness and the most healthy conditions in places to which light has most ready access.

The existence of three different kinds of rays has been clearly demonstrated, and it is possible that others exist.

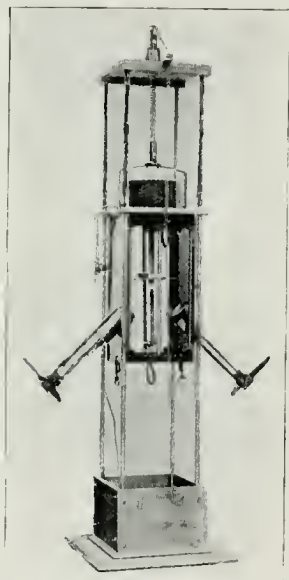
1. *Heat rays* (four hundred and ninety-seven billion vibrations per second), found near the red end of the spectrum, are for the most part invisible and do not impress the eye, but powerfully impress the nerves of the skin.

2. *Chemical rays* (seven hundred and twenty-eight billion vibrations per second)—violet and ultra-violet—make slight impression on the eye, but stimulate the skin in a remarkable manner, cause sunburn and bring about chemical changes or combinations in the tissues. The sun's rays have no chemical quality in and of themselves, their action depending upon the surface upon which the rays strike. The germ-destroying power of light is equal to the sum of its vibratory forces. It is these rays that make it possible to

photograph smallpox and measles before they become visible to the eye.

3. The *luminous rays* are centered near the yellow portion of the spectrum and are those which powerfully impress the optic nerve.

That light exercises a powerful influence over plant and animal life is well known. Plant



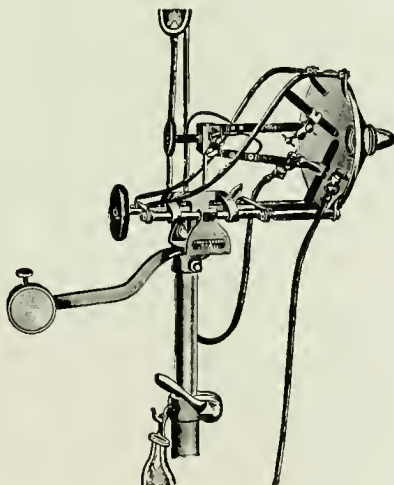
Modified Finsen Lamp.

growth seems to depend on the luminous rays, flowering on the ultra-violet and the aroma on the heat rays.

The turning of flowers, leaves and even stems toward the sun conclusively proves the influence of light upon vegetable organisms. Continuous exposure, however, proves injurious to plants, which require rest from sunlight as do animals.

Experiments show that electric light, properly employed, compares favorably with sunlight in its power to promote protoplasmic activity and to inhibit the action of bacteria. It acts as a tonic to plants and enables them to endure adverse conditions which they would not otherwise resist.

A very important character of light in connection with its use for curative power is its

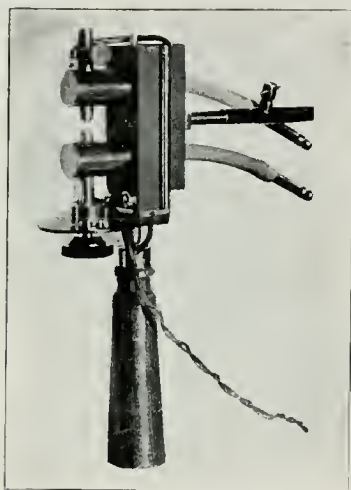


Modified Pinsen Lamp.

power of destroying bacteria. Various animals have been inoculated with diphtheria and other germs. Those animals kept in the dark died in from two to three days; those exposed to the rays of light resisted the effects of the inoculation. Many forms of germs are killed more readily by sunlight than by strong germicides.

The chemical or so-called actino-therapeutic rays can only be obtained from the sun or the

electric arc light. On account of the atmospheric absorption the arc light contains more ultra-violet rays than does sunlight. The incandescent bulb light has little actinic power and penetration. An increase in candlepower or number of lights will not give any practical increase in actinic power, comparable to even the smallest arc.

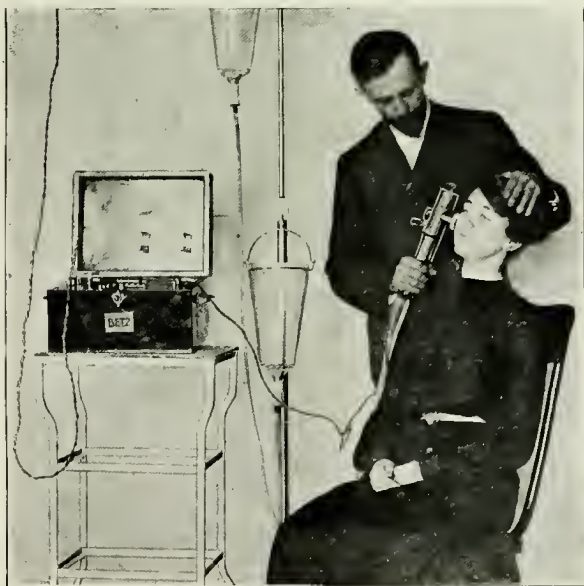


Showing Hollow Metal Electrodes in Lupus Lamp.

To Finsen the profession owes much for the thorough and scientific manner in which he has demonstrated the action of the chemical rays alone, and their usefulness in skin affections, especially those of a tubercular nature. His experiments show that the bactericidal effects of sunlight are found in the ultra-violet or chemical rays. He succeeded in separating the chemical from the heat rays by filtering sunlight, focused through quartz lenses, through a blue solution of copper sulphate in a dilute ammonia water, vary-

ing the strength of the solution to suit the intensity of sun's rays at the different seasons.

During the summer months Finsen uses glass lenses. As some ultra-violet rays pass through all glass, the deficient permeability of the collect-



Application of Lupus Lamp.

ing lens is compensated for by large size, thus making it equal in actinic power to a smaller rock crystal lens.

As sunlight is necessarily limited during the winter months, Finsen uses large arc lights of 60 to 80 amperes, each light having four condenser tubes, dividing the light so as to treat four patients at once. The tissues outside of the lesion are protected from the rays. A nurse wearing

dark glasses presses the compressor on the spot to be treated.

The tissues treated are compressed to empty the blood vessels, as opacity of tissue is due principally to red blood corpuscles. Compression is accomplished by a hollow crystal disk, which is cooled by a constant stream of cold water passing through it.

Various modifications of the Finsen lamp are now on the market. One of them is made with hollow iron electrodes, which are kept cool by the constant circulation of water. The beam of white light is cold. It is claimed for the iron electrodes that they are richer in chemical rays than the carbon, though carbon electrodes containing a large amount of iron and manganese also give a markedly violet flame.

The treatment usually lasts from one to one and a half hours, and is repeated until the parts are cicatrized. The area treated is usually one to three square centimeters.

There is no pain during the application; sometimes there is an itching and the surface reddens. A few hours later a vesicle filled with clear serum appears and dries in a few days, leaving a thin crust. Sloughing never occurs. The effect is simply that of an intense sunburn. Cure is not due to the destruction of tissue, but to the destruction of parasitic elements upon which the disease depends, and a quickening of vital activities of tissues, whereby their power of defense is increased.

The action of the light ray is a complicated one; aside from its bactericidal powers it influences the vaso-motor nerves and affects capillary dilatation. If the action of the light is continued for a length of time it causes a distinct endo-vasculitis, followed in time by a low grade

of inflammation and consequent permanent atrophy of the vascular tissue.

With an arc light of two to ten amperes only superficial dermatoses can be reached. A fifty to eighty ampere lamp will influence a photographic plate through the thickness of the human body. Investigators have not yet decided as to whether this property can be successfully employed in the treatment of diseases of internal organs. Several experimenters using fifty to eighty ampere lights report cures of various cases of carcinoma of the skin, epithelioma, rodent ulcer and Paget's disease, the result being equal to those obtained by X-rays.

The effects from the light treatment, being immediate, are controllable, which is a decided advantage over the X-rays, where the effect is only visible after a number of days or even a week or more.

In *Lupus vulgaris*, tubercular verrucosa cutis, tubercular ulcer, etc., the Finsen light treatment has been found to be the most effective and innocuous treatment. Finsen reports over one thousand cases, mostly cured, and has arrived at the conclusion that lesions which do not react under its use are not tubercular. *Lupus erythematosus* also responds to this treatment with about thirty-three per cent of cures.

Alopecia areata, when due to a parasitic disease, has also responded to this form of treatment.

Actino therapy has also been employed in various forms of birthmark, nevus, etc. The endo-vasculitis excited by the light finally leads to cicatricial contractions and obliteration of the redundant vessels.

BLUE LIGHT TREATMENT.

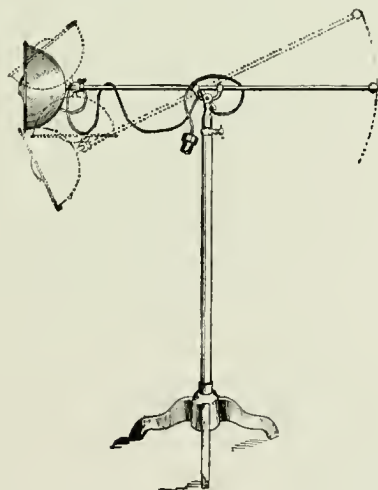
Professor Minin of St. Petersburg first called attention to the therapeutic uses of the blue incandescent light globe (in place of arc light filtered through a blue solution). These rays have a peculiar effect on the vasomotor nerves, causing a constriction of the blood vessels in the tissues exposed. A marked anemia is thus produced which frequently has a surprising pain-calming influence. Thus the pains of pleurisy, cutaneous inflammations and contusions promptly disappear, permitting a more thorough examination. Professor Minin even reports making painless incisions and stitches without the use of cocaine.

The constriction of the superficial blood vessels rapidly causes the absorption of infiltration about the edges of ulcers, and gives the impression that the ulcer is leveling itself and becoming smaller during each exposure. The ulceration is covered with a very thin membrane and becomes smaller. The edges of the ulcer are soon covered with skin of normal color and elasticity, and as these edges come nearer and nearer to each other, complete restitution of tissue soon takes place. Cicatrization does not pass through those phases ordinarily observed, because there is no development of connective tissue.

It goes without saying that in specific ulcerations the microbes which occasion them perish in the first place, and then only does the restitution of the ulcerated tissues commence.

The author has seen a severely infiltrated foot denuded of skin from the ankle down, following

a severe infection, become covered with the fine membrane above spoken of during the first exposure, which marked the beginning of a cure that took place in about six weeks. The condition had lasted over eight months, during which period the patient was in a hospital, from which he was discharged because he was unwilling to undergo an operation, or a number of operations.



Stand and Reflector for Minin's Ultra-Violet Light.

for skin grafting, which the hospital staff had decided were necessary to bring about a cure.

The infiltrated, bleeding edges and surfaces of malignant growths are rendered anemic, which frequently prevents the recurrent hemorrhages and relieves the pain in surrounding tissues. It thus accelerates the cure of such cases as are being treated by the X-ray. The secretions so fetid and plentiful in malignant growths are checked to a marked degree by a long daily exposure.

The parts surrounding the sore may be protected against prolonged action of the light. The effect of this light is to deplete the granulating surface of its blood, thus preventing tissue activity.

Bearing in mind the physical properties of this light, we find a wide field of usefulness for its absorptive, antiseptic and anesthetic powers, and its portability permits its use even by bedridden patients.

In phymosis due to chancre of recent origin the foreskin can frequently be retracted after five to ten minutes' exposure.

In orchitis the pain and swelling are greatly diminished after 10 to 20 minutes' exposure. The swelling about an infected area usually diminishes in about 15 to 30 minutes, to disappear entirely or to reappear in a milder form.

Excellent results have been reported from the use of the blue light in hematomas, sprains, housemaid's knee, articular rheumatism and weeping eczema.

The cure of a case of lupus by means of this light is reported by Prof. Minin. The patient had resisted a thorough treatment by means of the Finsen method. Others fail to confirm his claims.

In neuralgias the action of the blue light is to increase the pain, because it increases the already anemic condition of the nerves. In these cases, massage of the painful nerve tract with a ground glass incandescent light frequently gives great relief, for the action of white light is directly opposite to that of the blue light and increases the flow of blood to the parts.

The lamp is placed just near enough to the affected part to permit the feeling of slight heat, care being taken not to raise a blister. Treat-

ment may be given every other day for 15 to 30 minutes, or oftener as conditions may indicate.

Parts surrounding the sore spot may be gently massaged to improve local blood circulation.

This lamp is placed on the market under the name of Minin's Ultra-Violet Ray outfit, and has the four globes of different sizes as suggested by Prof. Minin.

ELECTRIC LIGHT BATHS.

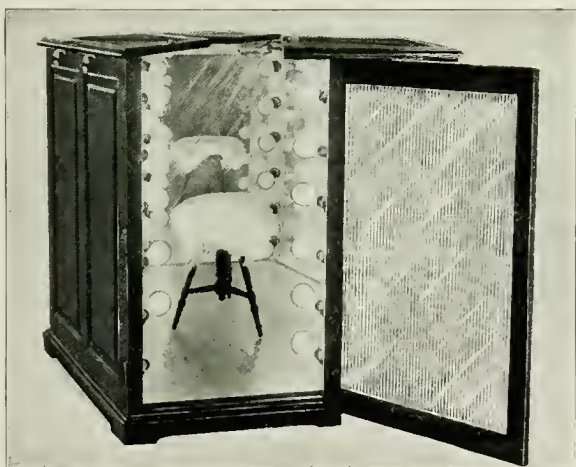
Sunlight is one of the most powerful tonics at our disposal, the various rays being present in the highest degree.

Next to a sun bath the incandescent electric light bath is the most useful and sensible. The heat in this bath is not derived from the air surrounding the patient, as in a hot air bath, but from radiant energy from the incandescent films. These rays pass through air surrounding the patient, without heating it to any considerable degree. As the rays enter the body they come in contact with various opaque structures, the resistance afforded by which converts radiant energy into heat.

Rheumatic individuals have noted the fact that when exposed to the direct rays of an arc lamp their condition seems to be improved. There are more heat rays present in an incandescent lamp than in an arc lamp, which is very rich in actinic rays, which are a direct stimulant for animal and vegetable life.

Light rays raise the body temperature the same as hot water, air or vapor. This rise of body temperature stimulates the metabolic activity of all the organs of the body, as is indicated by an increased production of carbonic acid. Animals eliminate more carbon dioxide under the influence of light than when confined in the dark.

Exhaustive experiments show that frogs throw off from one-twelfth to one-fourth more carbonic acid gas in the light than in the dark.



Electric Light Bath.

Experiments on dogs and rabbits give similar results.

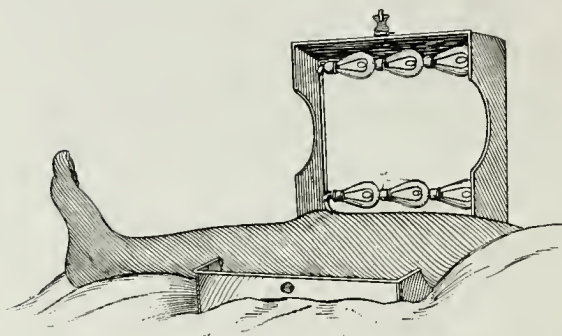
Metabolism is unquestionably stimulated by the reflex action set up by light rays upon the nerve endings of the skin and retina. Oxidation is increased by action of light and less carbon dioxide is eliminated at night than during equal hours of the day, even if an equal degree of rest be observed.

The stimulating effect of light, or rather heat rays, on the nerve endings in the skin brings about a relaxation of the cutaneous blood vessels.

The dilated cutaneous vessels, when filled, may contain from one-half to two-thirds of the total quantity of the blood in the body, thus relieving the congested visceral organs, as the liver, kidney, stomach, spleen and brain. Owing to cerebral anemia thus brought on, the patient often falls into a profound slumber. The heating of

the blood thus brought to the surface stimulates the sweat glands to active perspiration, and may increase this excretion from one and a half ounces to two or three pounds per hour.

The temperature of the blood in these widely distended vessels is frequently raised from four to five degrees Fahrenheit in fifteen minutes. This increase in body temperature is probably the cause of the increased production of carbon dioxide, with its remarkable reconstructive effect on the animal metabolism.



Local Light Bath.

General perspiration is produced faster than by any other known procedure. It frequently begins in three to five minutes after entering the bath, the temperature of which may be as low as 85 degrees. In a Turkish bath with a temperature of 170 degrees Fahrenheit it takes much longer. The cutaneous activity is greater than under any other sweating procedure.

The respiration also shows an increased elimination of carbon dioxide, amounting at times to 44 per cent.

The electric light baths are fast superseding all other kinds of sudatory baths, as they con-

tain, in addition to decided benefits of their own, all the benefits of the Turkish or Russian bath, which are withheld from many sufferers from heart troubles. The user of a light bath is in reality enjoying a pleasant sensation, just as if the body were exposed to a mild sunlight, whereas the long-continued use of the Turkish or Russian bath necessarily causes weakness. Light baths, on the contrary, strengthen and give tone to the system, and may be used on account of their strengthening and invigorating qualities.

Locally applied, the light baths are most effective in promoting absorption of exudates from joints and the pleural and peritoneal cavities. Even absorptions of exudates from the cornea and vitreous opacities have been reported.

The arc electric light bath possesses properties identical with those of the sun's rays; in the arc light the luminous and the chemical rays predominate; in the incandescent light the heat rays predominate. The results obtained by the employment of this bath are essentially those obtained by a sun bath. Patients, however, begin to perspire more quickly than when exposed to an ordinary sun bath. This may perhaps be due to the greater number of actinic rays in the arc light, which exercise a powerful stimulating effect upon the sweat glands, the duration of bath being from five to twenty minutes.

For practical purposes the incandescent light bath surpasses the arc light bath.

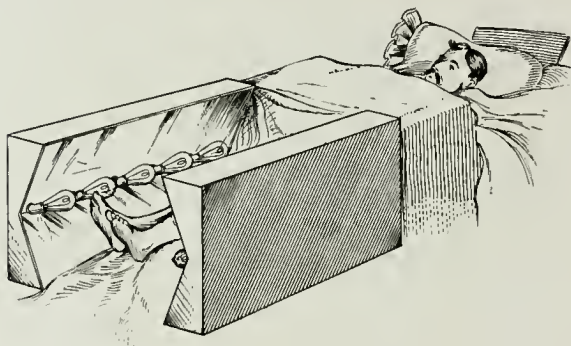
TECHNIQUE.

No light bath should be given without due regard to the time since the last meal; one hour and a half after a light, and two hours after a hearty meal.

The duration of a bath may be continued from three to ten minutes for a tonic effect, and from ten to thirty minutes for eliminative effects.

Urge patient to drink water copiously to encourage diaphoresis.

Moisten the face and scalp with cloths wrung out of water at a temperature of 60 to 65 degrees F. See that the feet are warm. It may be necessary to place them in a basin of warm water.



Light Bath, Patient in Bed.

To make permanent the effects obtained by the light bath they must be followed by a short cold application. The application of cold has the opposite effects to heat and is a powerful stimulant to all the organs of the body and a power for great good. It improves the tone of the organism by the reactionary excitation produced.

In feeble individuals, especially those suffering from neuralgic pains, a cold douche is frequently not advisable. Here alcohol may be applied to a small area at a time, and friction applied until it evaporates. The entire body should be gone

over in this manner to bring about universal contraction of the cutaneous vessels.

It is the author's custom to give his patients the benefit of a static breeze for about ten minutes after each bath, to make the benefits thus obtained more permanent.



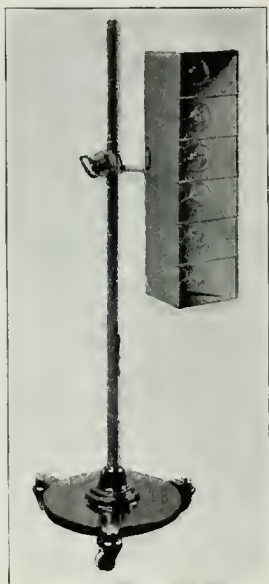
Incandescent and Arc Light Bath.

Light affects the great majority of diseased conditions in the most favorable manner, especially all those forms of disease accompanied by defective metabolism, characterized by defective oxidation, such as obesity, diabetes, uric acid diathesis, gout, Bright's disease, cirrhosis of the liver, rheumatism, etc.

Acne, eczema and even psoriasis have yielded surprising results on exposure to sunlight.

Spasm of the cutaneous vessels is relieved, permitting the blood from the congested visceral organs to come to the surface. Neurasthenia in all its forms is materially influenced as the blood improves.

The light cabinet is especially beneficial in toxic insanity due to spirits or drugs, melancholias,



Local Light Bath.

nervous insomnia and the various symptoms that may accompany a sclerotic condition of the blood vessels, kidneys and liver, various degrees of vaso-motor paralysis, tachycardia and arrhythmia, due to toxines, are notably diminished in irregularity during the bath. Strength and tone frequently continue for hours afterward.

Albumen and casts from the kidneys grow less and frequently disappear entirely without the use of drugs. The author has treated a number of cases of chronic nephritis where the apex of the heart was outside the nipple line. After three months' daily treatment it was found to have returned to almost its normal position.

Research has demonstrated that there is a relationship between every portion of the cutaneous surface with some internal area. In general, it is the skin overlying the internal organ that is reflexly associated with it. Understanding this relationship, it is readily understood that the volume of blood in any internal organ, no matter how remote from the surface, may be controlled to a certain extent by applications to the associated cutaneous area of a thermic or other agent capable of producing vascular change.

Thus congestions of a reflex nature interfering with the perfect action of an organ may be relieved by applications of light to the spine from the base of cranium down, or over the reflex cutaneous surface.

Prolonged applications of light and heat lessen the excitability and energy of the voluntary muscles (this is how heat relieves muscular spasm) and greatly increase the excitability of the smooth involuntary muscles.

A local light bath, applied to the hyperemic tissues, causes the distended capillaries to relax, permitting these vessels to fill with fresh blood, and secures a more rapid and complete oxidation of the effete materials, which are clogging the metabolic processes, into normal excretory products, in which form they are easily disposed of.

A three hundred candlepower incandescent lamp (not brought to a focal point) is very efficacious in the treatment of many skin diseases,

especially so in the various eczemas. Carbuncles may be aborted if the light is applied in an early period of development. Pain or soreness may be entirely relieved or greatly modified.

PART II.

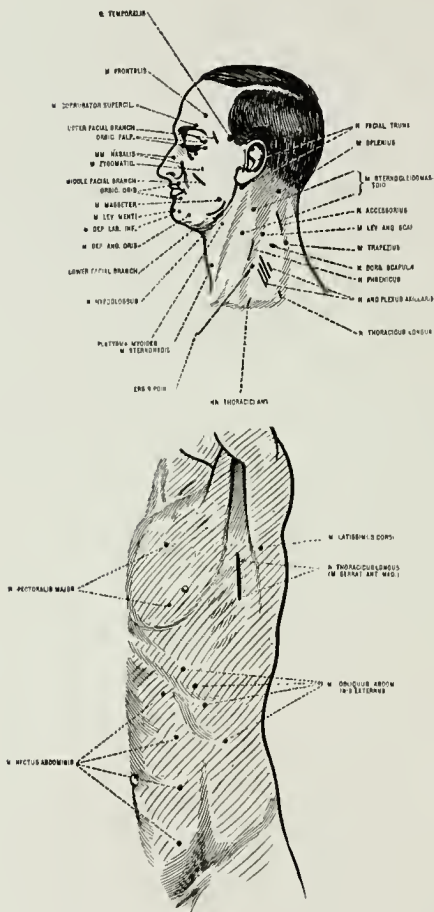
NERVOUS SYSTEM.

ELECTRO-DIAGNOSIS.

This includes examinations of the electrical reactions of diseased nerves and muscles. It presupposes on the part of the investigator a thorough knowledge of the human anatomy, physiology and pathology, as well as a familiarity of technique with electrical appliances. In making this examination the indifferent or positive pole is placed at a distance, and the negative pole, which gives the strongest response, is used as the active electrode. When the minimum response is compared with the corresponding healthy nerve or muscle on the opposite side of the body, it will be noted that similar positions of the coils will give similar results.

Normally, the first contraction in the series is always on closing the circuit with the cathode (negative pole), and the last on opening with the cathode (negative pole), anodic (positive), opening and closing contractions appearing with intermediate current strength. The current strength necessary to elicit cathodic (negative) opening contractions is usually painful. Stimulating a motor nerve stimulates the muscle to which it is supplied. Muscular tissue is a much better conductor of electricity than nerve tissue, with the result that the current takes the path of least resistance. Directly on entering the nerve it leaves and passes along the surrounding better conductors.

A reaction of degeneration exists whenever a muscular response presents either of the qualita-



Motor Points of Body and Face.

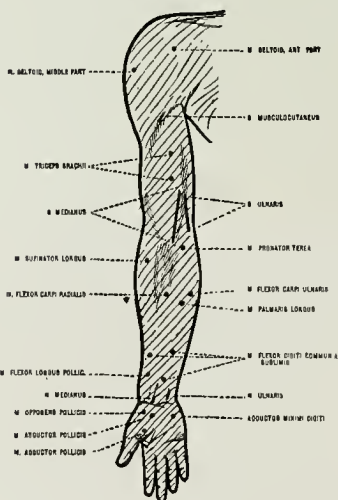
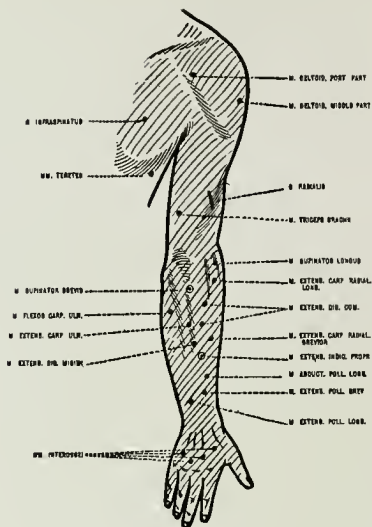
tive changes. The modal alteration from the quick jerk of health to the slow wave-like movement is an important accompaniment of degenerative reaction, and points infallibly to its existence. The phenomenon is readily detected by the eye.

A diminution or total extinction of faradic irritability is strong presumptive evidence of degenerative reaction, and a quantitative change in the galvanic irritability are the qualitative changes which usually occur.

Its occurrence indicates positively certain pathological changes in the nerves and muscles, resulting from their more or less complete separation from their trophic centers in the ganglion cells of the anterior cornea. If a motor nerve be divided, crushed or mutilated, the peripheral portion will degenerate. In two or three days the medullary sheath coagulates at the point of injury and a process of degeneration spreads rapidly toward the periphery into the finest ramification of the nerves, resulting in a cirrhosis of the nerves.

. Histological changes not only occur in the injured nerve, but in the muscles as well, finally undergoing waxy or fatty degeneration until the muscle mass is converted into a tough band of connective tissue.

In favorable cases regeneration occurs, but only after the trophic conductivity of the nerve has been restored. All forms of degeneration do not follow the typical course, for where the motor conductivity is only partially interfered with a large variety of phases are presented. For instance, we may have complete degeneration in one part of a large muscle supplied by several nerves and partial degenerative reaction in another part. Here we are apt to have a double contraction on direct stimulation of the muscle, the healthy por-



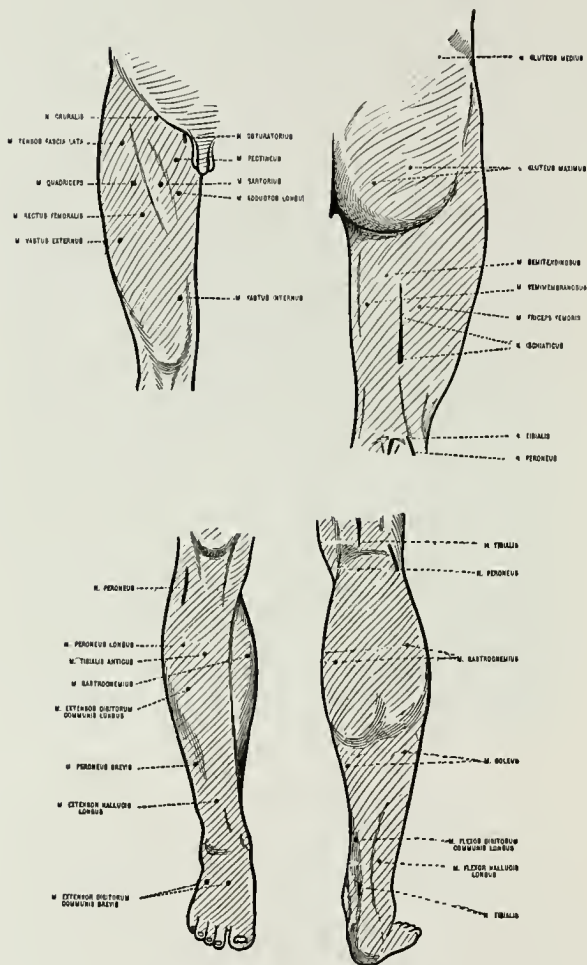
Motor Points of Arm.

tion contracting quickly and the degenerated portion contracting much slower. The same nerve trunk may present complete nerve degeneration in one part of its course and the partial form in another portion.



Anodal Electrolysis in Neuritis.

Diseases in which reaction of degeneration is present in certain muscles are neuritis of motor nerves (traumatic or idiopathic), multiple neuritis, poliomyelitis, bulbar paralysis, lead paralysis, atrophic lateral sclerosis (early stages), certain cases of diphtheritic paralysis, cases of myelitis caused by injury, toxic agents or pressure of intra-spinal hemorrhages, tumors, syphilitic depos-



Motor Points of Lower Extremity.

its in which there is a partial degenerative reaction as shown above.

The examination of sensory nerves is not as important as that of motor nerves, though it is more accurate than other means employed.

The reaction of degeneration gives a definite result and enables the physician to form a prognosis and to institute rational treatment.

Reaction of degeneration at once excludes the brain, the white matter of the cord, hysterical paralysis, idiopathic muscular atrophy and shamming.

All peripheral diseases in which the integrity of the nerves has been seriously compromised, as the result of injuries, pressure or morbid growths or rheumatic influences, show the usefulness of electrical examinations.

In a case of lessened mobility of a limb or muscle it will clear up the question between a cerebral and a peripheral seat, the presence of a full faradic response or of degenerative reaction being conclusive.

An examination will differentiate between cerebral, peripheral and lead palsy, and in unsuspected cases of the latter will enable a diagnosis to be made in the absence of other conclusive signs.

From the above list it will be seen that the usefulness of electrical examinations is by no means extensive, yet its indication may be of great value.

Nerves of special sense respond to electrical stimulation with a sensation corresponding to their particular function. The cathode (negative pole) is more irritating than the anode (positive pole). The supra-orbital nerve is usually chosen as a test for the sensory nerves, and response is usually most marked on opening and closing the circuit.

The galvanic current is used in making this examination. In locomotor ataxia it is of especial value. The sensibility of the whole body is often found very much decreased. Sensibility to pain is generally affected in proportion to the general sensibility. In certain cases there is complete analgesia. When the affection is unilateral the difference of the farado-cutaneous sensibility on the two sides can often be clearly brought out.

MODE OF PROCEDURE.

Place the patient in an easy position on a couch or chair opposite the examiner. Place the indifferent electrode at some distant part of the body, the sternum for instance, and maintain a steady contact. This electrode should be large and well moistened, so that local action will be kept at a minimum. Start with the negative as the active electrode. There must be no variations in the conditions under which the tests are made other than the change of polarity. The sponges should be well moistened in bicarbonate of soda. The muscles of the parts to be examined should be relaxed. The active electrode should be small, say four-fifths of an inch in diameter.

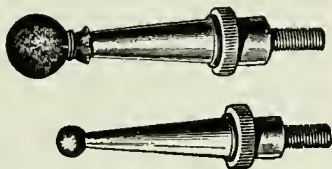
It is not always easy to find the motor points at once, notwithstanding the operator's knowledge of where they should be, as the overlapping of muscles and adipose tissue and the natural variations of distribution give considerable range for variety of situation.

We begin our examination with the faradic current, as it has a diagnostic value peculiar to itself. If there is much degenerative change in the motor nerve or muscle structure they fail entirely to respond to the brief and sudden impulse of the induced current. If a muscle or nerve is found, therefore, to respond to the in-

duced current, this in itself is evidence that the muscle is not undergoing degeneration.

In making a diagnosis of diseases of children, such as infantile paralysis, where it is necessary to know the exact condition of motor nerves and muscles as a guide to treatment, it may be necessary to chloroform the child, as the currents used are at times quite uncomfortable and even painful.

Note the weakest current that induces the first visible muscular contraction. After having examined the nerve trunk to test its irritability, we go over the motor points. Repeat this with the



Erb's Electrodes.

galvanic current and note the number of milliamperes needed to produce the first visible muscular contraction.

It is very important to know whether the positive or negative pole is over the nerve, and whether the contraction occurs at the opening or closing of the circuit. The polarity of the electrode may be changed and the same fact determined for the minimal contractions.

In the more delicate shades of degenerative reaction this mode can alone be depended upon to give exact facts. Produce vigorous contractions at cathode closure and note carefully the extent; note number of milliamperes used. Reverse the pole by the commutator. Increase or diminish the current until the same number of milliam-

peres are in the circuit and then note the extent of the contractions at the anode closure.

Complete the examination by similar observation at anode opening and cathode opening, the original number of milliamperes being carefully maintained.

The irritability of a nerve is increased when first visible contraction is caused by a current of less strength than normal, and diminished when a stronger current than normal is required to excite muscular contractions. Increased muscular irritability is present in the early stages of locomotor ataxia, chorea, etc.

Having found the spot where the weakest current produces the greatest individual action on the part examined, it is marked with an indelible pencil for further ease in identification, and the current is then alternately decreased and interrupted until a mere trace of contraction is visible.

Atrophy from disuse and from inflammatory joint diseases is characterized by diminished irritability. To determine with certainty increased nerve irritability the resistance of the skin over the parts treated must be accurately measured.

Muscles react to the faradic current in the same manner as they do to the motor nerve. The faradic current contracts muscles by stimulating the intramuscular nerve fibers and increases the irritability of motor nerves. There is little electrolytic action caused by this current.

A slowly interrupted current causes contractions of the muscles at each break in the current, while the rapidly interrupted current causes tetanic contractions, the muscle having no time to relax between each electrical stimulus to the nerve.

When the disease is unilateral, the opposite healthy side is used for comparison. If the dis-

ease is bilateral, the electrical reaction should be compared with some other nerve or muscle whose reactions are known to have nearly the same value. Any of these nerves may be taken as a standard of comparison when same nerve on both sides is involved. We may get response from a muscle through stimulation of the nerve when response from the muscle direct gives a marked degenerative reaction.

Examinations of corresponding sound parts are used as comparisons; the electrodes in size and current interruptions must be the same. Equal pressure should be brought to bear on the electrode, for where the degenerative changes are slight, carelessness in this regard may leave an error in diagnosis. It is not always easy to determine the exact amount of current, as the overlapping muscles and adipose tissues and other natural variations give considerable range in variety of situation.

The disappearance of electro-nervous excitability coincides with the degeneration of the nerve structure.

Farado-muscular excitability disappears with established degeneration of intramuscular nerve fibers and motor end plates. The last contraction to disappear is anodic closure.

If regeneration takes place in the nerve, voluntary impulses are the first to be transmitted. This is shortly followed by conduction for electrical stimuli. The muscle begins to respond more sharply, the sluggish contractions gradually disappear and the negative takes its normal position in the polar series.

When we propose to apply electrical stimulus to a single muscle the active electrode must be applied accurately to the motor point of the muscle or the motor nerve filaments supplying the

muscle. Care must be taken to prevent the current from reaching muscles that should not be stimulated, lest our object in giving treatment may be defeated, as in the correction of deformities. A muscle must always be stimulated in a relaxed condition, and a disregard of this important rule makes the treatment harmful rather than beneficial, as overstretching of the fibrils and tendons may take place.

Repeated practice in locating motor points on oneself as well as on patients is necessary to acquire proficiency in electrical diagnosis.

SPINAL DISORDERS.

From the incurable nature of most spinal cord diseases, too sanguine predictions must not be made.

In some instances the diseases are cured, in others their course is arrested and alleviated, while in still others not even the symptoms are relieved. As a rule, diseases of the spine are well advanced before they are recognized. Could an early stage of the process be detected, we might be able to arrest it.

For the special anatomy, physiology and pathology of the spinal cord the reader is referred to the standard authorities. The essential point in the treatment relates to the localization of the part of the cord affected. The most invariable effect due to electrical stimulation of the peripheral nerves and their end organs is the improved nutrition of the patient, the patient frequently gaining in weight irrespective of the improvement which may or may not ensue in the disease. Just how much stimulation will do harm or how much do good will depend upon clinical observation, each case being a law unto itself.

The morbid processes of the spinal cord are divided into a number of classes:

1. Functional.
2. Nutritional.
3. Anæmic and hyperæmic.
4. Hemorrhagic.
5. Neoplastic.
6. Inflammatory.
7. Degenerative.

If we exclude the hemorrhagic and neoplastic, which are of rare occurrence, the remaining pathological states are more or less interwoven, their nature being that of a chronic fibroid condition. The sclerotic process is an active one and not one of decay, nutrition being very active.

Toxic agents, as alcohol, lead, etc., and the poisons of infectious diseases, fatigue, overexertion, imperfect metabolism, auto-intoxication due to uric acid, etc., produce a neuro-paralytic condition. What is more natural than that the nerve cell, bathed in a fluid toxic to its nutrition and life, should die.

Toxic paralyzes are peculiar in that they begin their recovery the moment the poison is eliminated. Oxygenation of the tissues effected by electricity at once becomes a question of prime importance. Weak galvanic currents should be passed through the paralyzed limb or limbs. Static electricity may be used as a general nerve tonic.

If it is desired to produce excitation, the interrupted galvanic current is used, while if sedative effects are desired, apply the anode (positive electrode) of the galvanic current. If we wish to excite generally, we place the anode (positive electrode) at the feet and move the cathode (negative electrode) up and down gradually over the whole body surface, and frequently interrupt

or change the current direction. If we wish to excite cutaneous anæsthesia or muscular atony, the whole surface of the body may be gone over by the faradic brush or wet sponges. When there is increased excitability, faradism is contraindicated. The venous engorgement of the extremities found in paretic stupor improves



Using Faradic Brush for Cutaneous Stimulation.

when treated by the interrupted or labial galvanic current.

In making a spinal application the patient may sit sideways on a chair with clothing loosened at the back. Two spinal electrodes are used, about two and a half by five inches, the positive being placed immovable on the lumbar region and the negative held in contact with the cervical and various parts of the median and

dorsal region, and in turn giving a stabile or stationary current in each region for one minute. A current of ten to seventy milliamperes may be used, according to the patient's tolerance. The faradic current is not employed in this manner, as it would doubtless fail to act on the cord or deep-seated nerve roots. A more effective application than this is the abdomino-dorsal application, placing a large pad upon the abdomen and sliding the thoroughly soaped electrode up and down the back, using about forty milliamperes, more or less, according to the patient's tolerance.

Long percussive sparks to the vertebral column, small sparks, such as are easily borne, to the muscles, friction or rubbing the electrode over the entire skin surface, and a Leyden jar current, are especially useful in spinal cord diseases. No chemical decomposition attends its flow, but in place of this great molecular disturbance takes place. The resistance of the human body is practically nil to this current, it being especially adapted to reaching and influencing the spinal marrow.

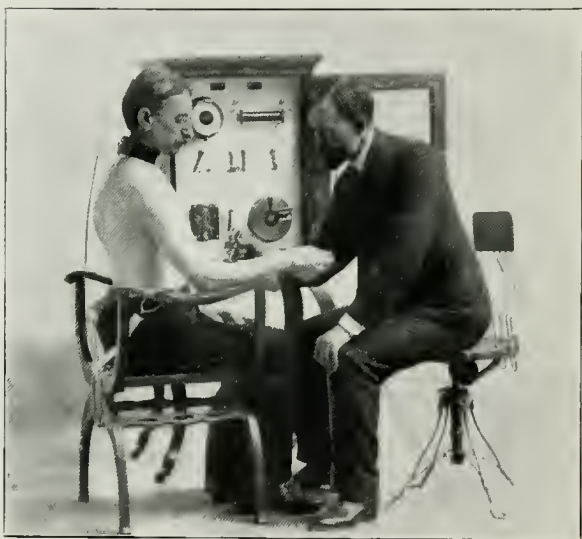
Infantile paralysis offers frequent indications for the use of electricity. The muscles, whose faradic contractility is only partially lost, may be expected to recover completely, either spontaneously or under treatment.

The injury of an organism or any part of it during its epoch of growth produces a much more profound effect than if received after growth has been completed, when it is only necessary to maintain the status of nutrition.

We are not justified in waiting for spontaneous recovery. The aim should be to allay the hyperæmia of the spinal cord, which is one of the elements of the initial myelitis when this

really exists, and when the paralysis is not due to peripheral neuritis.

The arrest of the circulation which occurs at the beginning of inflammation can be dissipated, provided the blood vessels have not yet become agglutinated, hence its value in creeping inflammations of the nerve centers. Electric currents



Faradic Stimulation.

promote circulation in the blood vessels and lymphatics.

The conductivity of the axis cylinder of nerves should be maintained by the passage of constant electrical currents, as a substitute for the nervous currents which have ceased to pass, and to maintain the nutrition of the muscles by means of electrical stimulation in place of volition. The con-

stant current contributes to the nutritive regeneration of ganglion cells, nerve fibers, muscle fibers, by its catalytic influence, and promotes the development of adjacent neuro-vascular elements to assume the functions of those hopelessly destroyed.

In an exposed nerve traversed by a constant current the excitability of the segment at the positive pole is diminished. At the negative pole it is increased. This is one of the fundamental laws of electric physiology. By the prolonged passage of the current a nerve may be completely paralyzed, so that for a while it ceases to respond to faradic stimulation. This experiment shows why the positive pole of the galvanic current acts as a sedative agent to nervous irritation.

As these cases frequently recover spontaneously, it is difficult to prove the nutritive value due to faradic contractions. The distinguishing characteristic of the faradic current is that it elicits and promotes functional activity, and this is only indirectly and under favorable circumstances a stimulant to nutrition. Since the functional activity implies and depends on the processes of disassimilation, it would seem at first as if such activity should be sedulously avoided in cases of paralysis and only rest sought. The muscular atrophy occurring in many cases of paralysis is due largely to inaction; hence artificial stimulation must be resorted to to a limited degree.

Infantile paralysis may require treatment for a long time before recovery. A period of two years may frequently be assigned in advance.

In *acute poliomyelitis* the treatment may be begun as soon as the signs of the acute inflammatory stage are over. This is often as early as the second week. Employ the galvanic current upon

the cervical or lumbar enlargements. The site of the disease is covered with a large electrode, while the other electrode is applied to the anterior part of the body. By the aid of a pole changer first the positive and then the negative poles may be employed for one or two minutes each. The negative electrode may also be placed stable over the site of the disease and labile or stable to the nerve trunks or muscles, the anode (positive pole) being placed at an indifferent point, as in the hand or on the sternum.

In paralysis of the milder forms the reactions are all normal, paralysis being only a symptom, the nerve trunk being incapacitated by disease for carrying motor impulses. Where a single group of muscles is involved, the disease is generally confined to the nerve trunk supplying this group.

The study of the reaction of degeneration locates the seat of the lesion and separates in a broad way diseases of spinal and cerebral origin, and excludes hysteria and shamming. Nevertheless, we must remember that grave spinal and cerebral lesions may be present and nearly normal electrical reactions take place.

It may be stated as a general rule that the more complete the reactions of degeneration, and the longer they have been manifest, the more unfavorable the prognosis.

If the electrical reaction is normal, the disease may disappear in a few weeks.

If partial reaction of degeneration is present, the disease usually lasts a few months, and when reaction of degeneration is complete, the disease usually lasts from six to nine months, or even longer.

In making a prognosis, the etiology of the disease must, however, always be taken into consideration.

In *diphtheritic paralysis* the cord is only exceptionally affected. The paralysis usually is peripheral in character and tends to spontaneous recovery, but the rapidity of the progress depends on the functional nutrition. If this is imperfect the paralyzed condition may drag on for months. In case nerve degeneration and muscular atrophy supervene, the paralysis may become permanent. Hence it is important to aid nutrition by means of drugs. General faradization is indicated, although local applications may be made directly to the pharynx. The faradic current is preferable to the galvanic. If the galvanic is employed, it must be without interruptions, which tend to exhaust the affected muscles.

Study the nerve distribution from the spine to the affected region. A contracted muscle after an injury may bring direct pressure on a nerve fiber, or a plexus, cutting off its function and causing paralysis in its area of distribution. In such cases the result is seen directly upon the parts supplied by the combined nerves; it is uncomplicated in other parts of the body and is manifested in a circumscribed area; namely, in muscle groups supplied by the nerve or nerves in question.

If the trouble is due to an auto-intoxication, such as we find in anterior poliomyelitis, where the source of trouble lies in the bowels, we frequently find that flushing of bowels and the hot air bath to eliminate the poison from the system, as well as stimulation of liver and kidneys, are of great aid.

It may not be amiss here to acknowledge the value of lymph hypodermatically administered, in cases of paralysis due to auto-intoxication or auto-infection. Early administration is advised.

A child suffering from a severe gastro enteric infection developed marked cerebral symptoms.

Paralysis of the optic nerves and absence of reflex to light were present. The child had slept with its eyes wide open, even when under the influence of an opiate, which had to be administered to prevent shrieking and restless tossing about. This condition had been going on for about a week when the patient was seen in con-



Anodal Electrolysis for Neuritis.

sultation by two specialists, who made an unfavorable prognosis—they had never seen a child with such severe involvement recover the use of its faculties. It occurred to the author that as the use of lymph had been followed by favorable results in case of adults, it might be employed in this case, while the active cause was still in progress. Two injections were made four hours apart, and were followed by a normal sleep with

closed eyes. A marked improvement was noticeable after eight hours. Three injections a day were made for the next four days. At the end of this time, the child had recovered the use of all its faculties and was able to recognize everything that was going on, even calling for his playmates.

If the action of the trophic centers in the cord which control the nutritive processes is impaired, thereby complicating the paralysis, the parts affected rapidly become soft and atrophy. In brain lesions, the trophic centers not becoming involved, the motor mechanism suffers only from disuse, and thereby secondarily affects general nutrition. In peripheral paralysis, if exercise of other parts of the body is not impaired, only the part paralyzed suffers.

Stimulation tends to preserve the balance of nutrition, which is restored and degeneration thereby retarded. If it is due to a blood clot on the brain or congestion of the brain or cord, or embolism, stimulate the cervical centers of circulation to assist in its absorption. This can be accomplished where the clot has not had time to become organized or encysted.

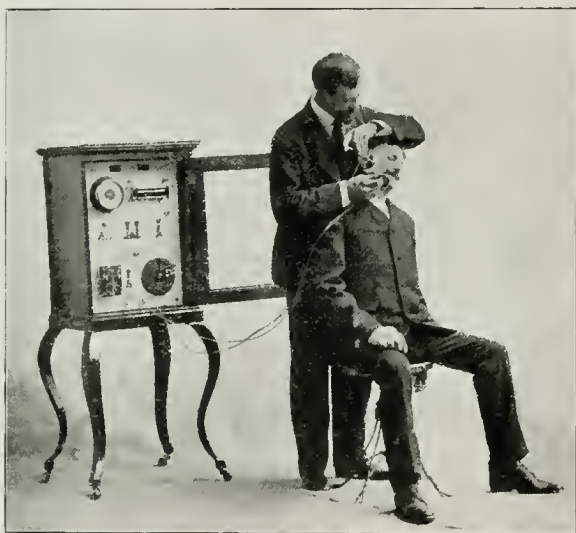
In paralysis the wave current should be applied over the organ itself and the trophic centers in the spine, increasing nutrition and relieving arterial tension. Activity in the organs is quickened and absorption hastened, removing the pathological condition and establishing collateral circulation in the parts previously cut off.

Contractions as a rule do not take place in the paralyzed limb during treatment. A treatment should last at least 20 minutes, with about a four-inch spark-gap. The high-frequency current is also a great aid in these cases and relief is sometimes very speedy, especially if the trouble be of central origin. One electrode is placed over the

sensitive spot of the brain (which is easily localized by means of the electrode), while the other is placed over the nerves supplying the parts.

In chronic cases, soften the contracture, build up the circulation, increase the nutrition to the tissues and tone up the local nerve mechanism.

In treating the muscles of face an electrode handle should be used which permits the opening



Faradic Current in Facial Paralysis.

and closing of the circuit without removing the electrode from the surface of the skin. Treatments should be every other day.

In *facial paralysis* the muscles can be stimulated by the induced faradic current from static machine with much less pain to the person than either galvanic or faradic. This is especially valuable in treating children.

In *atrophic paralysis* the galvanic current is superior to the faradic current. It excites a movement of the liquids in the plasma of tissues favorable to nutrition, while it arouses no function in either muscle or nerve. There is no danger of fatiguing either from premature activity. The reason why the faradic current may be beneficial is that it does not reach the wasted ganglion cells, and if limited to the skin by a dry brush, does not penetrate to the paralyzed muscles or motor nerve.

With static electricity success is obtained only in cases of recent paralysis, and in cases where the disease advances slowly. There is, of course, no remedy that will resurrect a dead cell. In many cases the vitality of the neuro-muscular elements is so profoundly smitten that recovery is impossible, for the injury may have been so widely distributed that no element remains intact.

In diseases of the brain electricity is considered useless by many, while some claim that it permanently injures the nervous system of children.

There is no form of nervous trouble or disorder where the various forms of electricity are more serviceable in effecting a restoration to normal conditions than in neuritis. It assists nature in clearing up the debris resulting from the invasion of inflammatory exudates, thus removing the vulnerable condition of the nerve trunk, which makes it prone to a recurrence on slight provocation.

The operator possessing a good working knowledge of the physical and physiological effects of the various electrical modalities, and having made out the pathological state of his patient, has, as a rule, no difficulty in choosing that form of electrical action best adapted to meet and counteract the abnormal states.

In *trauma*, over-stimulation will retard rather than promote the nutrition and restoration of nerve function. The treatment should be the application for five to ten minutes daily of the galvanic current, followed or preceded by vibratory massage and Swedish movement, and will be quite sufficient. The length and vigor of treat-



Galvanic Stimulation of Trophic Centers in Spine and Solar Plexus.

ment should be increased as the nerve begins to respond more actively. When the function has been restored the induction-coil current, with slow interruptions, can be substituted for the direct current. Gentle contraction of the muscle supplied by nerve may be thus effected, and in order to arouse the sensory nerves the faradic brush should be passed over the area of sensitive

distribution with a current strength quite perceptible to the patient.

Lesions of the olfactory and optic nerves are not amenable to electrical treatment by galvanic current. The application of the electrode to the optic conjunctiva is exceedingly painful. Indeed, it is possible to injure the refractive media of the organ with too strong a current.

In *perverted functioning of the brain*, arising from either nutritive or circulatory disturbances, the indications for its use are generally empirical. In many cases the nature of the trouble forbids more than a hope of amelioration, while in others unexpected results have followed its use. The first point to be considered is the form of electricity to be used.

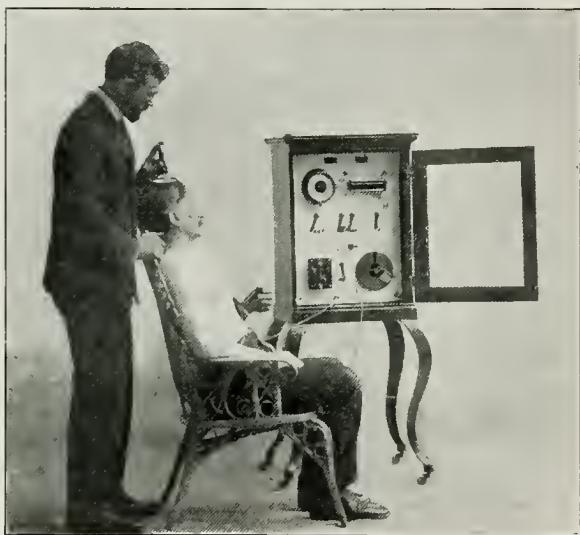
A galvanic current of great amperage affects the brain, the spinal cord and the sympathetic system more powerfully than currents of even the highest tension. The amperage also gives it a more potent electrolytic and thermic action and also greater influence on the secretions.

A current of from three to thirty milliamperes may be applied for a minute or more, according to the susceptibility of the patient. Begin with a weak current and increase until the metallic taste is perceived in the mouth. The cranial center, the summit between the ears, is especially important in central galvanization. A current traversing from this point to the solar plexus is sure to affect an intensely vital area. Avoid sudden interruptions in giving applications to the head.

The current should not be strong enough to produce cutaneous irritation. The vasomotor action of the current is the one chiefly desired in brain diseases, hence the galvanic current is largely used, though either current may be used. Where there is a congested disk there is contra-

indication to the use of faradic. The current should be two to five milliamperes, one electrode on the forehead and the other on the nape of the neck or over solar plexus, the treatment lasting from three to five minutes.

In applying electricity to the brain a large, well-moistened flexible electrode should be used,



Central Galvanization.

the hair also should be moist at point of application, and great care should be exercised in turning the current on and off.

In the use of the poles the best results are obtained by using both poles successively at each point of application. If we wish to increase the flow of blood to the brain the negative pole is placed over the forehead, and if we wish to di-

minish the flow of blood to the brain the positive electrode is used.

If the galvanic current is passed from the forehead to the occiput, or from the summit of the head to the stomach, little vertigo follows. If, however, the current be passed from temple to temple or from mastoid to mastoid, a very decided dizziness at once appears and becomes more decided the moment the circuit is broken.

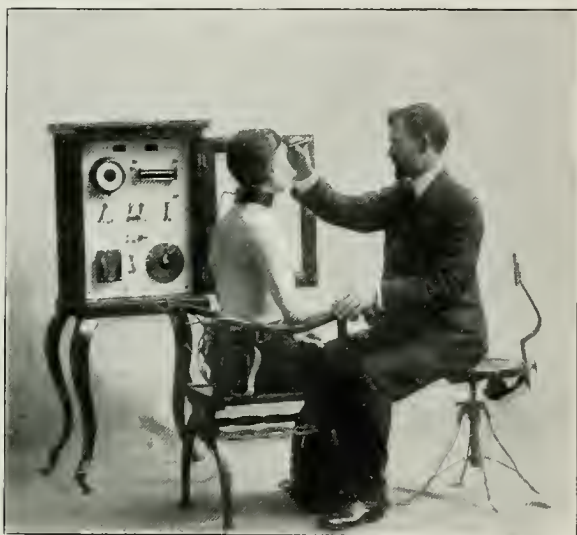
Whenever the expected results do not follow the theoretically indicated pole, the contrary pole should be tried. The galvano-faradic current is sometimes very effective as a tonic when everything else fails.

In *mental diseases*, which are usually indications of deep-seated organic changes in the cerebrum, the symptoms are frequently successfully combated. Many cases of mental derangements, insomnia, extra and intra-cephalic changes, congestions of the face, epigastric oppression, false perceptions of sense, such as taste and hearing, may be successfully treated. The galvanic current controls these factors by re-establishing the deranged circulatory conditions and controlling the factors which cause the mental trouble. Turgescence of the veins of the brain really constitutes a withdrawal of so much blood from the efficient circulation.

Electricity, if used carefully and perseveringly, may be a valuable remedy. Weak currents excite and stimulate the circulation, a medium current promotes, strong ones hinder it and very strong extinguish it. Hence it follows that strong currents should never be used. Where it is desired to produce a change in nutrition the constant current should be used, the anode (positive electrode) being placed at the back of the head and the cathode (negative electrode) placed at

the extremities in the form of a foot plate, metal plate or sponges.

Hallucinations and fixed ideas are disorders which are frequently amenable to electrical treatment. The positive pole may be applied to the superior cervical ganglion of the great sympa-



Central Galvanization.

thetic on each side, and negative pole moved slowly on the same side from the region over the eyebrow to the occiput. The periods of treatment may vary from a week to a year. Developmental insanities and morbid mental irritabilities, due to rapid growth, have been effectively treated with electricity. Insanity of the climacteric, which usually takes the form of mania or melancholia and in lactational insanity excellent

results have been reported from its use. In general paralysis of the insane alleviation may be looked for. The insane condition frequently found in aged people usually arises from nutritive enfeebleness and is most amenable to treatment, and next to careful alimentation, electricity is the most valuable therapeutic remedy for this trouble.

Psychic disorders having their sources in exhaustion and overwork frequently respond to the static current. Electricity is of little use in attacks of mania, though many cases of improvement under its use are reported.

The results obtained by electricity in *cerebral hemorrhages* have been variable, but owing to the lack of other remedies, its use is almost always justifiable. The applications should, of course, be deferred until the danger from cerebral fever has subsided. The treatment consists in galvanization of the injured portion of the brain, as well as of the injured muscles. Faradism of the brain is always contraindicated, weak currents doing no good and strong currents liable to do harm. By the peripheral treatment of the muscles, etc., the brain is also reflexly stimulated to assist in the restoration of conduction to the motor nerve tract.

In *hemiplegia* the large electrode of the positive pole is applied to the nape of the neck and the other is placed on the diseased side, so as to include the lesion between the two. The hair should be well moistened. The treatment is much the same for all cerebral paralysis, varying only with the seat of the lesion and the affected muscles. Should there be paresis or paralysis of the diaphragm faradization of the phrenic nerve is indicated.

Headaches.—The treatment of this trouble should be preceded by a careful investigation into the cause and the treatment directed to the starting point.

In practically all forms of headaches there are contractions of the cervical spinal muscle. These contractions are, as a rule, easily relaxed by means of the static spray or high-frequency ap-



Applying High-Frequency Current by Means of Hand.

plication. As the vaso-motor system, controlling the circulation of the body, has its location here, relaxation of these muscles and ligaments has a marked influence in relieving headaches; at least, temporarily. Manipulation or manual pressure over the vaso-motor nerve centers about the head, face and neck will frequently relieve a headache.

Congestive headaches are frequently relieved by application of the high-frequency current; the operator, holding the glass electrode in one

hand, applies the current to the patient's head with the other. To begin with, the spark gap must be very small, and the current should be hardly perceptible to the operator's hands. A half-inch spark gap may cause the patient to faint. In making application to the patient's head a number of intensely sore spots are usually found, which will disappear after a few moments' application, when the spark gap may be widened.

It has been suggested that this means might be utilized in making diagnoses and in locating brain tumors.

Chronic headaches at the base of the occiput are frequently relieved by placing the positive electrode over this region, with the indifferent electrode in the hands or on some other part of the patient's body. The current strength to be applied must be governed by the patient's sensitiveness.

The pain of Neuralgia is usually due to pressure on the nerve filaments by spasm of its nutrient vessels, as well as by compression of the nerve trunks by the overfilling of the blood vessels in the contiguous area. Consequently the pain is often relieved by simple relaxation of the nutrient vessels in the nerve trunks, drawing away the stagnant stream of nutrient material.

In neuralgia of the fifth nerve, cervico-occipital neuralgia, cervico-brachial neuralgia, it is absolutely necessary to bring about a relaxation of the muscular fibers of the neck. Manipulation of the muscles of the neck, with moderate pressure and vibration over the painful locality, frequently brings relief in two to three minutes.

Prompt relief from pain is frequently obtained from galvanism in neuralgia and it certainly exercises a curative influence. Spinal tenderness is often completely cured by electrization. Electricity may relieve the pain and not affect the

pathological process, which may be uninfluenced and run the regular course.

In applying electricity the rule is to use the weakest current which will produce perceptible action, but no violent contractions. The anode (positive pole) should be placed over the seat of pain, successively, at the points of emergence of the several nerves, the cathode (negative pole) being firmly fixed over the upper surface of the vertebra. Avoid interruptions of the circuit. Apply daily for ten minutes.

In *sciatica* release the tissues along the entire course of the nerve. This is accomplished by stimulation of the spinal centers from the first dorsal down, and vibration along the entire course of the nerve.

Relaxation of the tissues about the sciatic notch is absolutely necessary. In chronic cases of *sciatica* the wave current, localized over the nerve exit and over sciatic notch, is very effective. Long sparks applied over the nerve track frequently give great relief. Although cases are often cured in a short time, many cases call for patient continuance of treatment. Deep vibratory pressure by hand just above the thigh in the iliac fossa is frequently followed by instant relief, when all other methods fail.

In acute cases of neuralgia a hot static spray over the origin of the nerve, static brush discharge, and the high frequency current over the course of the nerve for 20 to 30 minutes, as well as applications of Leyden jar currents, are very effective, though it must be remembered that almost any kind of electricity may aggravate the symptoms at first treatment.

Exposure of the painful parts to the X-rays will frequently be followed by immediate and wonderful relief in otherwise stubborn cases of

neuralgia. If the neuralgia is of a toxic nature, electric light baths are indicated.

Intercostal neuralgia is frequently relieved by counter-irritants. It is on this account that the static spray is very effective. The faradic brush frequently acts very favorably, and galvanism will often relieve promptly and permanently. The positive pole is usually placed over the vertebræ and the cathode, or negative pole, near the sternum, or vice versa. The pain is usually relieved by the first galvanization.

Coccygodinia is due in most cases to either an arthritis or a neuritis. Static modalities seem to be successful in almost every case where the treatment is continued. The prognosis is generally good unless inflammatory products deposited restrict motion. The wave current or sparks are indicated to promote the reabsorption of the products of inflammation.

Exophthalmic Goitre—This form of neurosis is undoubtedly greatly benefited by means of the galvanic current. That it is entirely cured by electricity alone is very improbable. The positive pole is placed at the nape of the neck, the center of its lower border corresponding with the seventh cervical spinous process. The negative electrode should be moved up and down the side of the neck from the mastoid process along the course of the great occipital nerve. Several applications a day of a weak current (2 milliamperes) for five minutes to ten minutes give marked relief to the patient. Treatment may be applied by patient, as it is inconvenient for a physician to treat a patient that many times a day.

Chorea—This disease does not seem to be favorably influenced by any form of electricity, while vibratory stimulation over the entire spine

and over the sides of the neck seems to have a very soothing influence upon the patient. Flushing the lower bowels and dilating the sphincter have been most effective in the author's practice in connection with medicinal treatment.

Epilepsy—Unless due to heredity or brain lesion, a fair percentage of cases get well under proper treatment. In these cases the cause is usually found in some lesion which interferes with the nutrition of the cord or brain, or irritation of the motor nerve-strands running to the peripheral motor structures, exciting the connected nerves, or an auto-intoxication due to the obstruction of lymph and venous circulation. The exciting cause may be in the intestines, and diet must be carefully regulated.

Treatment—Stimulate the spinal centers in the cervical region as well as those from the middle dorsal to the last lumbar region, by means of vibration, and give the wave current to the upper spine, and the spray over the solar plexus daily. If due to auto-infection a hot air or electric light bath will be a great aid.

Static electricity may be applied for its tonic effect and for relief of nervous irritability.

Hysteria, being a functional disease of the nervous system, is frequently found to depend on some lesion which disturbs the nervous equilibrium. There is usually some actual derangement responsible for the altered conditions in those of neurotic temperament.

Treatment—Stimulation of the entire spine, especially the dorsal and sacral regions; friction sparks to entire body; sedative spray over pelvic organs; wave current with electrode applied to lower spine to correct circulation in the colon, intestines and genitals. Stretching of the sphincter muscle was followed by relief in a number of the author's cases.

All the numerous *occupation neuroses*, such as those of musicians, telegraphers, seamstresses, barbers, drivers, milkers, cigarmakers, penmen, etc., are in reality starvation neuroses and manifestations of a more or less severe obstruction of nerve supply. The occupation which brings about these conditions usually requires the elevation of the right shoulder, resulting in drawing the upper ribs together and approximating the clavicle and first rib in such a manner as to bring pressure to bear upon the brachial plexus.

Treatment consists in stimulating the vasomotor secretory and trophic centers involved by means of mechanical vibrations, and making a liberal application of short sparks to the ball of the thumb, muscles of the forearm, neck and cervical spine, followed by friction sparks. Always relieve the obstruction or the pressure on the nerve. In stubborn cases the arm may be placed in a water bath and treated in this way by means of the wave current.

Counter-irritation by means of the static spray or high frequency application over the clothes will remove the weary, tired feeling.

Locomotor Ataxia.—In this trouble the electrical examination of common sensation is of special interest and value. The sensibility of the whole surface of the body will often be found to be very much decreased. The sensibility is usually affected in proportion to the general sensibility, but in certain cases there will be absolute and complete analgesia to the strongest current. In unilateral affections the difference in faradocutaneous sensibility can often be clearly brought out.

Aconite applied by means of cataphoresis frequently gives relief for the dorsal neuralgic pains in locomotor ataxia. Application must be made for five or ten minutes, and eight to ten drops

may be applied at one treatment, with a current strength of five or six milliamperes.

The absorption of toxins from the bowels usually aggravates the dorsal pains, hence colonic flushings must not be neglected while receiving electric treatments.

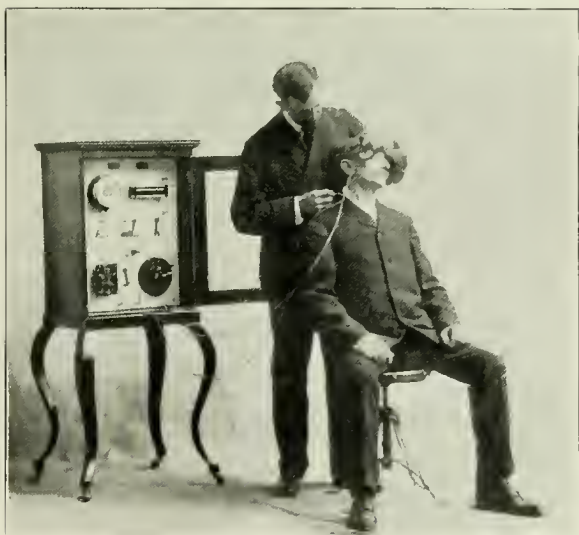
Bladder pains of locomotor ataxia may be greatly relieved by systematic application once a day of the fine wire faradic current through the parts affected, the negative pole being applied over the sacrum and the positive pole over the symphysis, and the gradual increase of strength with the fine interruptions until the limit of pleasant toleration is reached. Application should be from ten to twenty minutes.

There can be no doubt as to the beneficial effect of electricity in this affection. The important symptoms may be caused to disappear and the patient made comparatively comfortable during the initial and ataxic stages of this disease. As a chronic disease it demands chronic treatment. Treatment should be galvanization with a moderate current strength of two milliamperes to a square inch for ten to twenty minutes daily, with the electrodes over the nerve extremities, one at the nape of the neck and the other one on the lumbar region, or one electrode may be placed on the sternum, while the other one is applied to the spine.

It is important not to neglect the treatment of the nerve roots and the peripheral nerves, since they, as well as the posterior column of the cord, are in many instances the seat of pathological change.

When patients under galvanic and faradic treatment fail to show improvement, recourse should be had to static electricity, as under this treatment improvement frequently results almost immediately when other currents have failed.

Thick percussive sparks, from four to eight inches in length, should be administered over the spine to the nerve roots and trunks, to peristethic areas and to all points from which ingoing impressions may be caused to impinge upon the spinal gray matter, or to affect the spinal circulatory mechanism. The density of the



Galvanic Current in Megrin.

charge from a static machine is likewise sufficient to afford a powerful rubefacient effect to the cutaneous nerve distribution.

The wave current from the static machine with the electrode on the spine (treatment 30 minutes daily) has in the author's experience been most effective in relieving pains of ataxia.

Insomnia is only a symptom of some underlying pathological condition, and whether this

condition be due to infection or auto-intoxication. it must be remembered that there are always a number of cerebral cells in an unusual state of vigilance while they should be in repose. This perverted cerebral circulation must be corrected before the cells can perform their normal functions.

While receiving the static breeze, patients suffering from insomnia often fall into a refreshing physiological sleep, due to lowered arterial tension, which in turn is followed by lowered frequency of the heart's action and increased volume of pulse. Internal congestion and strain upon the heart muscle are relieved by dilatation of the integumental blood vessels. This lowered tension in the blood vessels also has the effect of aiding respiration, which becomes less labored, less frequent and deeper. As a sedative to the nervous system static electricity surpasses the hypnotic and sedative drugs by inducing a return to normal sleep, and assures its popularity wherever its uses are known.

Vibration over both sides of the neck, as well as stimulation of centers in spine from seventh dorsal up; hot static spray over the spine, liver and solar plexus; wave current over the liver, and electric light or hot air baths, are all agents that tend to correct or combat the underlying pathological condition.

When static methods fail, try central galvanization; it may prove itself more efficacious.

After applying the current for one to two minutes over the vertex, move it over the sternocleido-mastoid muscle, the object being to influence the pneumogastric nerves. Make application on both sides of the neck. Then apply the current to the entire length of the spine.

Avoid interruptions most studiously. Observe the effect on pulse and respiration. If more than

two milliamperes are used move the negative electrode about in order to prevent electrolytic action. The positive pole is usually the active one, because the indications for general galvanization usually call for tonic sedative effects.

In the treatment of this chronic and obstinate symptom, general faradization should never be forgotten. It increases the nutrition of brain and spinal cord, sends richer blood to a fatigued and exhausted stomach, increases peristalsis of the intestines and relieves constipation.

The liver and spleen acted on by the alternating currents applied locally may be made to exercise their specific action on the intrapelvic organs without use of the internal electrode. The effect is dependent on electro-motive force and on the smoothness and the number of interruptions.

In paralysis of the diaphragm the galvanic current should be used, the positive pole against the outer border of sterno-cleido-mastoid muscle, the negative pole upon the epigastrium. In a case of laudanum poisoning the galvanic current may have to be applied for hours, until the respiration has risen to about twenty per minute and the contracted pupils have become dilated.

In chloroform narcosis the galvanic current, passed through the phrenic nerve, has been successful in some cases.

We are told, however, that there is danger of stimulating the vagus at the same time that we stimulate the phrenic nerve. This stimulation of the vagus would readily arrest the action of an already failing heart. Therefore, to avoid reaching the vagus, electrolization of the phrenic nerve must be reserved as a last resort. In ether, opium or aconite poisoning it is safe to try to stimulate the phrenic nerve, because in the first

case the heart is not depressed, and in the second case the heart's action is rapid and feeble, and it is desired, if possible, to exercise some inhibitory action. In the third case, the pneumogastric nerve is paralyzed and would not respond to electricity.

Faradization of the thorax is frequently followed by increased respiratory efforts, and is frequently used in the same conditions in which inhalations of oxygen are now generally employed with advantage. The stimulation must be addressed to the nervous mechanism, which controls the respiratory act.

Lead Paralysis—The distribution of the paralytic effects of chronic lead poison varies greatly. Static sparks to the spine and muscular surface of the trunk and extremities are a great aid in assisting other methods of elimination. When atrophy has taken place local applications of the faradic and Leyden jar currents are indicated. Painters having slight attacks respond to treatment much faster when with it are associated various static modalities.

DISEASES OF THE ALIMENTARY TRACT.

In *spasmodic stricture* of the œsophagus, which is usually associated with the neurasthenic state, hysteria, etc., electricity may be applied for the purpose of reducing reflex excitability. The galvanic current is to be preferred. The negative pole may be placed on the back of the neck over the cilio-spinal center, while the positive is held just over the sternum or over the border of the sterno-cleido-mastoid muscle. If this fails an insulated œsophageal electrode, with a metal tip, should be introduced in the œsophagus to the point of spasm. Great caution must be exercised, on account of the proximity of the pneumo-gastric nerve. The faradic current may also be used, applied to the constrictor muscles of the pharynx, and is sometimes very effective.

In *stricture of the œsophagus* cathodal electrolysis with a current of ten or fifteen milliamperes may be used, treatment lasting from three to twenty minutes. The electrode must be more flexible than the ordinary œsophageal bougie made for gradual dilatation.

Hiccoughs are undoubtedly of a reflex origin. Galvanization and faradization of the phrenic nerve have been resorted to with marked success. The treatment is the same as that for paralysis of the diaphragm.

Vibratory stimulation to the spine has been successful, following one treatment, where the

various other forms of electricity and drugs were unsuccessful.

Firm pressure on the phrenic nerves for a few minutes will sometimes relieve an obstinate case of hiccough in a few minutes.

Hyperæsthesia of the stomach and vomiting.—These symptoms are frequently an expression of a neurotic condition, rather than of a gastric disease. If of a purely neurotic origin, there is usually no nausea present. Electricity, as a rule, greatly benefits these cases and general faradization and galvanism are frequently very effective.

In atony of the stomach—The integrity of the digestive powers depends on the tone of the muscular tissues of the stomach, as



(Esophageal Electrode.

well as upon the healthy action of the nerves and nerve centers. Indigestion in many cases depends upon deficient gastric secretions rather than on lack of muscular tone. Lack of muscular tone develops gradually. Indigestion due to atony causes no pain, while epigastric tenderness is almost invariably associated with an inflamed condition of the mucous membrane. Many cases improve rapidly under electricity when used in connection with other proper hygienic measures. The tendency of electricity is to increase secretory processes and modify their quality.

The appetite is sharpened, digestion is quickened, constipation relieved.

Patients in whom hydrochloric acid was absent after a test meal frequently showed hydrochloric acid after internal faradization.

An excellent means of studying the variation of nutrition through electricity is found in the examination of urine. This is believed to be a result of oxidation, taking place either in the kidneys, in the tissues, or in both. There is no single chemical change which explains growth and sustenance of the body. Electricity passing through the body modifies many of these processes. Animal nutrition is a process of enormous complication. In applying the faradic current the electrode should be sufficiently large to prevent any undue concentration of current, and the electrode over the region of the stomach should be kept in almost constant motion. The rapidly interrupted galvanic current is also of value in these cases, though inferior to the other currents. The peristaltic movements of the stomach depend upon the integrity of the vagus nerve, and anything that interferes with its accelerating influence interferes with peristalsis.

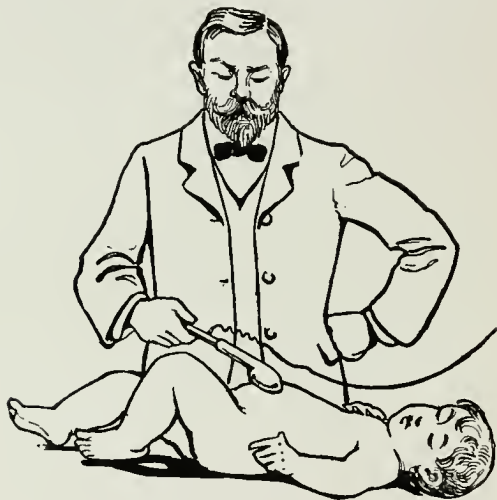
In the author's hands the high frequency current applied to the region of the solar plexus by means of the glass electrode has been a most effective measure in these cases, improvement being noticeable in a very short time. This is especially true in infants where, due to the distended condition of the intestines, we practically find an immovable diaphragm. This effect on the respiratory organs produces a condition of insufficient oxidation and when we realize that every chemical change in the body is one of oxygen we see why this current with its abundance of oxygen applied directly to the parts is so effective. Gastro-enteric infections also show a marked improvement under this treatment, and

make a much more rapid recovery than ordinarily.

In treating *gastric dilatation* Einhorn's electrode is used, and can be swallowed by the patient the same as a stomach tube.

All kinds of electricity affect gastralgia favorably, varying with the individual.

Spasm of the stomach also yields to electrical treatment.



High-Frequency Current in Atonic Dilatation of the Stomach.

In paralysis of the intestines and consequent constipation, the nervous system may be at fault, the muscles losing their contractile power, due to enervation. Thus, disease of the spinal cord itself may produce intestinal paralysis. Constant dilatation due to retained fæces may also cause it. When there is any depreciation in the tone of the muscular and nervous systems both the galvanic and faradic currents may be used. If the galvanic current is employed the cathode (nega-

tive pole) should be placed in the rectum, the current hardly exceeding more than two or three milliamperes. If used with an interrupted current one to two milliamperes are sufficient. The strength of the faradic current is safely left to the sense of the patient. Whatever can be borne without great discomfiture can be safely used. The internal electrode should invariably be the negative.

Constipation, if treated by electricity, sometimes yields rapidly. The positive pole is placed over the liver, the negative moved slowly in a rocking motion from the right inguinal region upwards and downwards on the left side over the



Stomach Electrode.

descending colon, and repeated several times in the same way, the treatment lasting twelve minutes, and with twenty to twenty-five milliamperes. Three applications a week should be made. A round rectal electrode inserted in the rectum may be used on the positive pole if a strong effect is desired.

The static wave current applied by means of a rectal electrode (the metal tip being inserted well above the sphincter muscle) exercises the intestinal muscles and brings about peristaltic movements obtained in no other way.

Chronic diarrhæa is favorably influenced by general faradization. Combined with frequent and prolonged applications to the abdomen and back, general faradization seems to have not only

a direct local effect upon the affected parts themselves, but a most invigorating influence upon the system at large.

In *prolapsus ani* apply faradic current, high tension, with the positive pole at the prolapsed part and the negative pole over the abdomen, the current adjusted to the tolerance of the patient. Treatment should be made three times a week.

Hemorrhoids are usually caused by an impediment to the return of venous blood from the hemorrhoidal veins, and are as a rule accompanied by constipation. The cause of this inter-



Rectal Electrodes for Static Wave Current.

ference may be found in any of the areas of the spine that regulate the circulation and muscular tone of the abdominal and pelvic viscera, and obstruct portal circulation.

Many severe cases have been treated by vibration of the lower spinal centers and the solar plexus. The high-frequency current, applied to the rectum by means of a glass electrode, usually relieves a good deal of local congestion at the first treatment. The active cause of the trouble (constipation) can frequently be reached by means of the static wave current applied by means of a rectal electrode. A spark-gap of at least four inches should be employed. This pro-

duces a powerful massage which affects the entire alimentary canal. The swelling method with variations may also be used with success.

Fissures—High-frequency currents affect some cases favorably. When this form of treatment is effective, improvement will be noticed after two or three treatments.

Fissures are also readily treated with a silver probe used on the cathode (negative) pole to lightly cauterize the raw surfaces with a current of three to ten milliamperes. When a copper wire is used as the anode (positive pole), the treatment should continue until the tissues are stained green with the dissolved copper. The current is then reversed for a few seconds until the wire is free.

In stricture of the rectum electrolysis will frequently keep the intestines patent as long as the malignant disease allows the patient to live. A treatment lasting from one to twenty minutes, with a current of five to twenty milliamperes, according to seat and nature of the trouble, and repeated in one or two weeks, is recommended.

RESPIRATORY TRACT.

In *atrophic rhinitis*, aside from constitutional treatment and attention to hygienic measures, local applications of the galvanic current by means of the negative electrode with one milliampere current, repeated three times a week, have given favorable results in cases in which the atrophy had not advanced too far.

In *fetid atrophic rhinitis* cupric electrolysis has brought about cures where all other methods failed. After thoroughly cleansing the parts they should be anesthetized with a cocaine solution. A copper electrode attached to the positive pole is inserted well into the tissues of either middle turbinal. A current of from five to ten milliamperes is applied and continued from three to ten minutes. A new needle must be used at each treatment, as electrolysis roughens the surface of the needle. Should the needle adhere, reverse its polarity by means of a pole changer and apply a current of two milliamperes for about two minutes. The results of this treatment favor the theory of the bacterial origin of this disease.

Diseases of the Ear—Tinnitus aurium is frequently amenable to electrical treatment. If either the anode or the cathode modifies or arrests the sound during application of the current, the prognosis is favorable and treatment should be continued.

The ear electrode covered with moist cotton is placed over the external canal of the ear; the re-

sistance between the electrode and the skin should be reduced as much as possible. The non-active electrode may be placed on any spot not in transverse direction from the ear undergoing treatment. Begin the current at zero and creep up at a snail's pace. At the first report of faintness or nausea stop. An increase of one milliamperere per minute and a decrease at the same rate is not too slow for correct technique. Don't break contact during the application of the current.

In *tonsillitis* of a chronic nature a compressed loop of platinum, heated to redness, may be plunged into the mouths of distended crypts.



Ear Electrode.

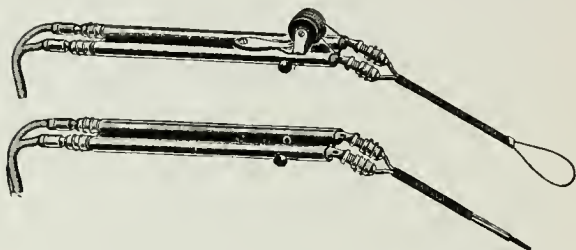
Pierce the surface at three or four points at each sitting. The operation should be repeated once or twice a week.

Obstructions of the anterior nasal passages may be successfully removed or relieved by the galvano-caustic loop. Pain is usually relieved by the application of cocaine.

In *tracheotomy* the galvano-caustic method has been employed by passing a curved needle, carrying a double platinum thread, into the trachea, directly through the skin and other superjacent structures, and then emerging about two centimeters above the point of entrance. The two ends were then connected to the two ends of a galvanic pile and the intermediate loop heated by a current and drawn through the entire mass of intervening tissue. The entire operation, as a

rule, does not cost a drop of blood, thus showing its advantages over a cutting operation in œdema of the glottis, neoplasmus, etc., where hemorrhage is liable to be an alarming feature. The platinum loop may be used for the removal of hypertrophied tonsils, but had best be reserved for exceptional cases, where hemorrhage is threatened on account of vascular anomalies or hemorrhagic diathesis.

Tubercular laryngitis—In this trouble cupric electrolysis applied by means of a laryngeal electrode to which a small bulb of chemically pure



Cautery Snare and Cautery Electrode Handles.

copper is attached has been recommended. The bulb is applied directly to the diseased area under full illumination from the laryngeal mirror. The larynx should first be anæsthetized with a cocaine solution. The copper electrode is connected with the positive pole, the dispersing electrode being applied to the neck. From one to three milliamperes should be used for five minutes at each sitting. The application may be repeated every second day. There is no real destruction of tissue under this treatment and no lacerations of any surface which might form a point of entrance for new germs, as is the case with curettement and cautery. The cure is effected by the healthy reaction of the tissues, in the

same manner in which we often see specific lesions heal when the system is under the influence of mercuries.

Asthma—The exciting causes of asthma are numerous, and the disease varies with the source of irritation. Both faradic and static electric currents have been used in various ways, and while successful in some cases, in many more they have failed. The electrodes should be placed on opposite sides of the neck at points from the angle of the jaw to near the sternum. The current should be a strong one and used for one-quarter to one-half an hour. It may be passed from the nape of the neck through the cardiac region. When the faradic current fails the galvanic should be tried. Galvanization of the pneumogastric has been successful. Sometimes the positive pole and sometimes the negative is placed over the nerve; that is, about the middle of the outer edge of the sterno-cleido-mastoid muscle. Weak currents should be used at first. Another mode of treatment has been to place the negative electrode over the sacrum and the positive over the spine for ten to twenty minutes at a time, or the electrodes may be placed on opposite sides of the thyroid cartilage. The various points should be tried until it is learned which treatment is followed by relaxation.

Angina Pectoris—In this condition galvanism promises more than medicine and frequently gives prompt relief, while persistent use of electricity frequently appears to produce a permanent cure. The current may be applied in several ways. The positive pole, placed with the broad surface over the heart and sternum, and the negative to the lower cervical vertebra, or the positive electrode may be placed in the supra-sterno fossa and the negative upon the cervical sympathetic ganglion, first on one side and

then on the other. The positive pole may then be moved to the lower cervical ganglion and the negative pole applied to the sensitive spots at the angles on both shoulder blades.

Asphyxia has been treated by electricity with a few brilliant results, but with more failures.

The faradic current should be used and applied by means of a large sponge electrode to the phrenic nerve along the insertion of the diaphragm into the thorax wall. The current first used should be strong enough to contract the muscles of the thumb vigorously. The current should be interrupted as often as three times a minute, and its strength can gradually be increased. If the faradic current fails, try the galvanic, though it is less frequently successful in re-establishing respiration. Place the positive pole over the epigastrium or along the attachment of the diaphragm with the ribs, and the negative on the phrenic nerve, that is, along the outer edge of the sterno-cleido-mastoid muscle just below its middle. Or, instead of this, the current may be passed transversely through the body at the horizon of the diaphragm. The current should be moderately strong. It can be conceived that a strong current might stop the heart when feebly beating.

Coughing can be provoked by passing a galvanic current from a negative electrode at the nape of the neck to the positive electrode on the dorsal vertebra by breaking or reversing the current. By this procedure tickling in the throat and coughing are excited.

The pneumogastric nerve can be galvanized by applying one electrode along the external border of the sterno-cleido-mastoid muscle a little below its middle and the other over the heart. In this way a rapid heart can be slowed to much uniformity.

The faradic current may be applied to the same point on the neck and over the cartilage of the seventh rib, or to other points where the diaphragm is inserted into the thorax, in order to stimulate a paralyzed diaphragm.

This treatment is also applicable to chloroform, opium and other drug narcosis and to drowning.

The author suggests that patients suffering from opium narcosis when brought to hospital be placed on the platform of a static machine, as sparks repeatedly applied are a stimulant that reach the vital centers as no other measure at our disposal.

PELVIC ORGANS.

Suppression of menses, dysmenorrhea, leucorrhea, prolapse of the uterus, etc., are all due more or less to faulty nutrition and circulation in the pelvis and can be relieved and improved only by removing the cause, which is frequently found in the obstructed and enlarged lymph vessels and venous circulation.

Electrical treatment as well as vibratory stimulation have both scored a decided success in the treatment of pelvic disorders, and in no place in the whole art of healing do patience and care accomplish as much as in the treatment of chronic pelvic disorders.

The more we know of electricity the more we hesitate in hurrying our patients to the operating room, as electricity lacks the horror of an operation as well as the dangers of an anæsthetic. Both faradic and galvanic currents are used.

The faradic current is a valuable stimulant to contractions and physiological exercise of the uterus. It restores tone to the impaired muscle structure in the pelvis, as found in the relaxed uterus of subinvolution and weakened states of certain muscular and fibro-muscular structures of the uterus, vagina and uterine supports.

In making pelvic applications of electricity have the patient assume the recumbent position, loosen the clothing and see that both the bladder and colon are empty. The electrode should always be warmed, and then anointed with glycerine or soap so as to facilitate its insertion. It

must be introduced with the greatest gentleness, avoiding contact with or pressure on tender spots.

The vaginal galvanic applications are necessarily monopolar. The active electrode can be pressed behind the exudation or enlarged organs, the indifferent pad being on the abdomen or back, and the electrode being so disposed as to include the diseased portion within the tract of the densest current line. The conducting surface of the electrode should always be covered, to prevent the cauterizing action on the tissues, the most convenient covering being absorbent cotton wound about the conducting surface, thoroughly soaped and lubricated with non-



Vaginal Electrode.

irritating soap, the cotton being detached after each application.

When it is desired to produce a determination of blood to the pelvis or uterus, the negative pole is made the internal or active electrode. When the contrary effect is desired the positive pole is used.

In the conditions in which intrauterine treatments are applicable, the amount of current strength depends upon the idiosyncrasy of the patient as to pain. It must be remembered that the same effect can be obtained from fifty milliamperes applied for twenty minutes that is obtained from two hundred milliamperes applied for five minutes. The powerful action within the intrapolar region would, however, be lacking, the weaker current strength merely effecting the cau-

terization. Again, the caustic effect of slowly liberated chemicals does not compare with that delivered *en masse*.

The thickened endometrium may be disorganized and broken up by the caustic action of the negative pole, so that it easily comes away in shreds. The softening action of the current relaxes the internal os, so that large pieces of membrane may escape. Fatty degeneration is hastened, with consequent softening. Electricity performs slowly without an anæsthetic what rapid dilatation and curetting accomplishes in a short time with an anæsthetic.

If the electrode is bare and the current sufficient to cauterize when concentrated, the electrode



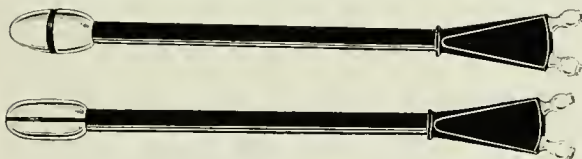
Vaginal Bipolar Faradic Electrode.

should be covered with cotton, to somewhat modify the effect. If simple positive cauterization is required the electrode should be either platinum or carbon, as cataphoresis will surely follow if a decomposable metal electrode is used. If it is desired to insulate the electrode, gum shellac heated over an alcohol burner will give a smooth, highly insulated covering. The covering should be sufficiently thick.

Intrauterine applications should never be made for neuralgias or general conditions of any character, they being reserved strictly for conditions involving organic changes of the organ itself.

There is no clear relative indication governing the choice between monopolar and bipolar faradic applications. Bipolar methods are usually

most effective in the control of pain, for which the finest wire coil is usually preferable, even if the patient affirms that she feels nothing. Both poles should be wholly within the cavity. The outer pole must not be in contact with the sensitive vulvar orifice, and pressure on painful spots should be avoided. The current from the secondary coils should be employed first, as it is the most sedative and its chief effects are to relieve pain and congestion. The application must always be grateful to the patient and never uncomfortable, hence vibration must be smooth. Continue treatment until relief and sedation are produced. In many cases it produces effects like opium. Repeat the



Vaginal Bipolar Electrodes.

treatment daily if parts are very painful. Because the positive is the more sedative, it is nearly always made the internal electrode of the bipolar, and is placed against the most sensitive point in the pelvis.

A large, relaxed and discharging uterus soon regains tone and diminishes in size, while the endometrium returns to its normal condition. Slow interruptions should be used with the coarse wire coil.

The fine wire coil cannot be employed in these conditions, as a larger volume of current is necessary than can be obtained from their use.

When the current is turned on the electrode should be held strictly immovable, as movement during application will bring about a disturbance

of the effect. Application should be from four to ten minutes daily, if practicable.

Direct applications in the uterus are sometimes necessary. This application is made by means of the bipolar electrode inserted into the cavity of the uterus. Both pole terminals must be wholly within the cavity, as contact with the canal or internal os is unnecessarily painful and would be unbearable or unendurable. The bipolar electrodes are only employed with the faradic or alternating current under strict asepsis. The static induced current may at times be thus employed.

Aside from the bipolar vaginal method, there are various methods of applying electrodes, as the utero-cervical, vagino-abdominal, vagino-sacral and lumbar, utero-abdominal and utero-sacral lumbar, lumbar hypogastric, recto-abdominal and recto-vaginal applications.

A much stronger current can be given with a bipolar electrode than with a monopolar.

In electricity, as in medicine, dosage is of primary importance. The dose, of course, is variable to a variety of circumstances. When the interval is too long between treatments the benefit of the treatment is lost, hence it is necessary that they reinforce each other at proper uniform intervals. The long-continued use of the positive pole causes contractions of the uterine cavity as well as of the cervical canal. If this contraction is too great a few treatments of the negative pole will relieve this condition.

The vagina and uterus are comparatively insensitive to electric currents, and much stronger currents can be used than on skin.

It may be well to have the patient rest a while before going home, and neglect of this precaution may cause serious congestion. The electricity should not be used during acute inflammation of the uterus or adnexa.

Infantile Uterus—Non-development of the uterus is frequently the result of overwork, either mental or physical, at the time of puberty, leaving but little of the vital principle for such organs as those of reproduction. The painful results following are practically a starvation neurosis.

The faradic or sinusoidal current with slow interruptions, applied by means of the dipolar intra-uterine electrode, should be employed, the whole influence of the current being concentrated in the uterus. The frequency of application varies from every day to once a week. To establish a cure it should be employed until the uterus develops to a normal size and condition.



Carbon Ball Electrodes.

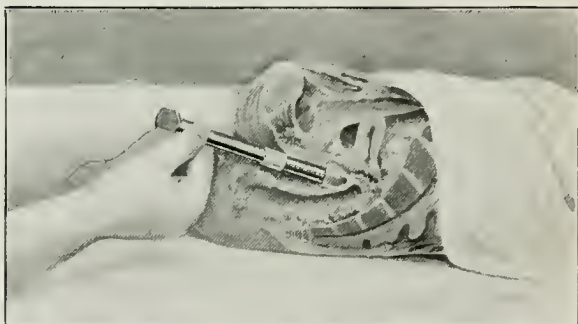
Scanty and irregular menstruation will usually respond to stimulating local applications to the cavity of the uterus, if made for a few days during the week immediately preceding the expected period.

During the intervals local applications are not necessary. If this condition is the result or is associated with uterine atrophy, whatever its cause, results are as a rule prompt when stimulating treatment is continued twice weekly during the intervals between the menstrual periods.

Dysmenorrhœa—Painful menstruation, when due to anæmia, seldom requires local treatment. A tonic course of electricity by static insulation, short sparks or spray to the spine, lumbar region and sacrum, is often a very efficient remedy in these cases.

If the dysmenorrhœa is caused by an obstruction of the cervical canal, negative electrolysis applied by means of a dilating electrode may be employed. The smallest sized electrode should be used in the beginning and increased in size at successive treatments, which may take place every three to five days. A current of ten milliamperes may be used for about five minutes. Sufficient dilation to overcome the obstructions and promote free drainage is required.

The most important use of the galvanic current in gynecology is to produce dilatation or a

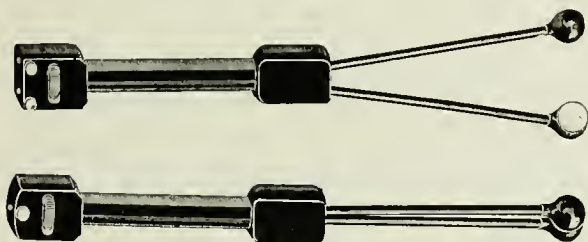


Vaginal Bipolar Faradic Application.

patulous condition of the canal of the cervix and secure drainage from the uterine cavity. An equally important effect, that is obtained at the same time, is a freeing or expansion of the orifices and ducts of the submucous glands and a thinning of their secretions, which permits them to empty more freely. It is a much more rational treatment than the older method of cauterization and astringents, the results being prompt and gratifying. The strength of the current should never be more than ten to fifteen milliamperes,

used for from three to five minutes, not oftener than every second day, better still, every third or fourth day. Drainage from the tubes is promoted when the obstruction is due to infiltration of the endometrium at the mouth of the tube and of the mucous membrane and muscular wall at its uterine end. The point of electrode is directed against the opening of the tube into the cornu of the side affected, or both sides if involved, but no effort is made to introduce it into the tube. These manipulations must be conducted under the strictest asepsis.

An inhibition of the excretions when due to muscular spasm is almost invariably due to a



Ovarian Electrode.

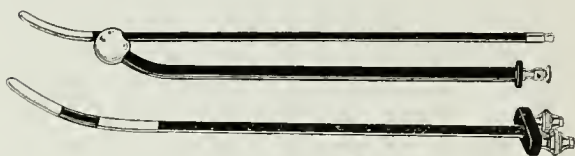
vaso-motor disturbance, consequent to abdominal torpidity and habitual constipation. Positive intrauterine applications may be necessary. Ten to twenty-five milliamperes are, as a rule, sufficient to bring about results.

Ovarian Congestion—Abdominal dorsal applications of both currents with general galvanic stimulation and massage usually relieve this trouble.

Relaxed abdominal walls may be frequently corrected by means of the faradic as well as galvanic currents, one pad being applied on the abdomen and another on the back. The pad on the

abdomen should follow the direction of the colon and pass down the flanks on each side. The current contracts the dilated intestines gradually, adding tone to the muscular walls.

Electricity at the bedside not only frequently replaces opium and other sedatives, but materially reduces the extent and duration of the inflammation. The electrode should always be warmed before insertion. The current from the long, fine secondary wire is used for fifteen to twenty minutes, and if great relief is experienced it may be repeated twice daily if necessary. Its use is not only followed by lessened pain, but by relieving the hypertrophied condition.



Bipolar Uterine Electrodes.

Drainage of the uterus by means of the negative galvanic pole may cure a considerable proportion of all cases, but if the progress is not as rapid as desirable intrauterine applications may be made. Twenty milliamperes will be ample during the beginning of the treatment, and applications may be made every four or five days. The vagino-abdominal treatment may, however, be continued as usual. Care must be taken not to aggravate the trouble, which would certainly occur in the presence of purulent inflammation.

Chronic Ovaritis—The normal function of the ovaries when inflamed may frequently be restored and adhesions loosened by the absorption of the bands of exudates by means of the bipolar fine wire faradic applications for five minutes daily,

or by the galvanic current applied by means of zinc or carbon covered electrodes with a current of thirty to sixty milliamperes.

Ovarian Neuralgia—Marked relief is usually brought about by the rubefacient effect produced by static spray or by means of the glass electrode of high frequency applied over the clothing about the lower abdominal and sacral regions. The static wave current with large spark gap may also be applied over the painful area.

Amenorrhœa, when the result of a chronic metritis, requires energetic treatment. Strong currents must be used to stimulate the impaired muscular structure of the uterus. When a metal electrode is introduced into the uterus and a strong current used the metal part of the electrode must not come in contact with the cervical canal, as the resultant cauterization is likely to result in a stenosis.

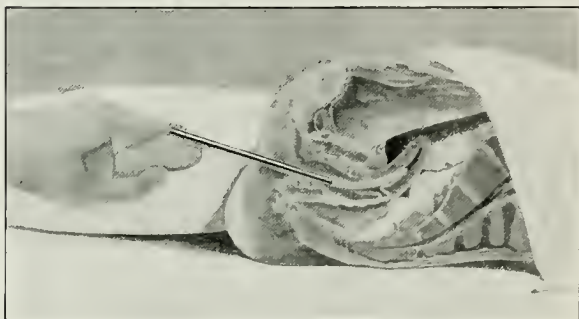
The bipolar faradic electrode must also pass wholly into the uterus, as the external os is extremely sensitive. The stimulation should be made as strong as can be comfortably borne. Some can bear only the fine wire coil, while others bear the coarse wire coil without apparent discomfort. Continue treatment four to five minutes twice a week or more.

Metrorrhagia—Endometrial hemorrhage is, as a rule, due to a diseased condition of the endometrium. When not contraindicated by accumulation of pus or septic exudates in the pelvis, tubes or ovaries, electricity may be used to combat this trouble, though it must by no means constitute the only remedy. It should usually be preceded by curettage. When the canal is not patulous it should be first dilated either by a steel dilator or by means of negative electrolysis to permit free drainage. The uterine canal

must be thoroughly irrigated to remove shreds of blood before each treatment, to permit the electrode to come in contact with the parts.

When positive electrolysis is used to control uterine hemorrhage, fifty to one hundred milliamperes will be required and must be continued for some time.

Metallic electrolysis is very energetic and penetrates to a greater depth, which is a decided advantage over dry cauterization by means of posi-



Applying Negative Electrolysis to Internal Os.

tive electrolysis. Copper or zinc electrodes may be used, copper being the most astringent as well as the most irritating. Zinc is followed by little irritation, but not by a profuse discharge, as is copper electrolysis. The cervical canal must be excluded from its action.

The electrode should fill the cavity as completely as possible, but if the cavity is longer than normal it will be necessary to act on each section separately. A current of fifteen to thirty milliamperes may be used for five to ten minutes, and if the electrode sticks the current should be reversed.

Irrigate the canal at least every twenty-four hours until application is repeated, which may be on third or fourth day, especially if bleeding is active and interferes with effective cauterization.

If the hemorrhage is due to hyperæmia of the endometrium, caused by engorgement of uterine vessels from pressure of tumor, etc., a vaginolumbar or vagino-abdominal application will often prove effective in controlling bleeding.

Subinvolution may be more successfully and quickly treated by means of electricity than by any other means at our disposal. Flagging muscular tissue rapidly shrinks after a few stimulating applications from a primary or secondary coarse wire coil. Discharges continuing after the normal period following parturition may frequently be controlled by one or two applications. If there is a morbid condition of the endometrium present the positive covered elastic uterine electrode is best suited, as its introduction causes least pain.

If a septic condition is present the positive mercuric pole may be used, on account of its bactericidal power.

The bipolar vaginal method is first used, because its action is more diffuse than when applied to the interior of the uterus. Application is of short duration to avoid tiring the muscles, and interruption should be sufficiently slow to permit physiological contractions and relaxations. This is borne without discomfort if the nervous apprehension has been previously overcome. Treatment should be every day in the beginning, and after two weeks every third or fourth day. If the impaired muscle structure responds poorly to the faradic current, an interrupted galvanic

current should be used, as its amperage or volume can be increased until response is elicited.

The bipolar vaginal electrode is also used to remove the obstruction in the tube and to stimulate the absorption of the infiltration of its walls and lining membrane. Great care must be exercised in acute cases. Being a stimulant, it may provoke undesirable and even harmful irritation by improper administration.

Uterine displacement—The treatment must be directed against the conditions operating to pro-



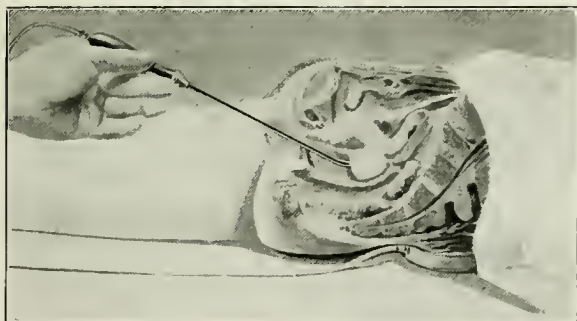
Applying Negative Electrolysis to Female Urethra.

duce it, subinvolution, endometritis, metritis, etc. The possibility of a cure without an operation will depend upon whether the tonicity of the sustaining ligaments can be restored and whether the uterus is movable or not.

Where the uterus is movable, but is restrained by the thickened utero-sacral ligaments, the treatment is directed towards the absorption of the inflammatory deposits in the surrounding cellular tissue. The negative electrode, with a current of from twenty-five to forty milliamperes, will have the effect of softening the parts, after which the

bipolar faradic electrode applied for about ten minutes will by its stimulating properties cause rapid absorption.

Cervical Endometritis—This disease is almost invariably an obstinate affection and of a penetrating microbic origin, and being almost always associated with corporeal endometritis. This being the case, zinc, mercuric cataphoresis or mercury on copper or silver is usually very effective if applied through the cervical canal with thirty



Electrodes in Position for Vagino-Lumbar Application.

to fifty milliamperes. The plain, positive current with a platinum electrode is frequently effective.

Endometritis—The simple catarrhal condition is usually due to a hyperæmic condition of the uterus consequent to constipation, torpid liver, exposure to cold, etc. Removal of the cause is the first indication. Applications of the static spray or spark or high frequency current by means of glass electrodes over the sacral and lumbar regions as a rule make local applications unnecessary. When local measures are indicated the faradic bipolar applications are as a rule suf-

ficient and produce effects not otherwise obtainable.

In chronic endometritis the secreting cavity of the uterus which is normally open becomes closed and normal secretions confined become a source of irritation. Negative electrolysis may here become necessary. Applications by means of a uterine electrode with a current of about ten milliamperes, continuing for five minutes, may be repeated every two to five days. Bipolar stimulation may also be used two to three times a week, as the case may demand, until free drainage has been fully established.

Septic endometritis—Positive electricity is here contraindicated. Metallic electrolysis has been recommended, but the author believes there is too much risk of spreading the infection to the tubes when it does not already exist there. The negative galvanic application to the interior of the uterus may stimulate and free the submucous glands and assist in removing the infiltration of the uterine walls. Stimulation by means of bipolar faradic applications should follow the galvanic application, as it promotes absorption and relieves the engorgement of the lymph vessels.

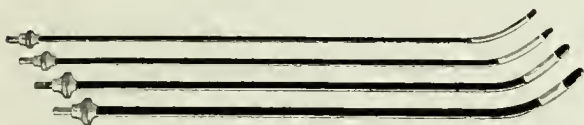
Metritis—This condition may persist after the inflammatory condition of the endometrium has disappeared and is sometimes most intractable.

Irrigation with a negative galvanic pole and a current of forty to fifty milliamperes sometimes gives great relief, if applied thrice weekly. In applying cauterization to the uterus it must be done in such a way as not to cauterize the uterine canal, which would defeat the purpose by subsequent cicatricial contractions.

If we desire to avoid deep cauterization it is absolutely necessary to keep the electrode in mo-

tion over the surface. If bleeding should supervene, the treatment must be suspended until it ceases. Never turn on more current than an inflamed organ can bear. The first treatments should continue for only five minutes.

Senile Endometritis—This condition of atrophic degeneration is coincident with the menopause. The uterine cavity is filled with irritating, excoriating secretions. The absorption of this material provokes general sepsis, owing to the constriction of the canal by bands of cicatricial tissue. As this cicatricial tissue will not stretch without tearing, negative galvanism with its dilating effect is the only proper remedy to employ.



Intrauterine Electrodes.

As the condition is a progressive one, it cannot be cured in a short time, though marked improvement often occurs.

The irrigator may be used as an electrode when the canal is sufficiently dilated to admit it. Application may be made every second day for three to four weeks, and once a week for the succeeding weeks.

Catarrhal Salpingitis—In acute cases of catarrhal salpingitis bipolar faradization carefully applied will relieve pain, lessen congestion and remove the tumefaction by stimulating the absorption of infiltration. This will promote drainage of the retained tubal secretions into the uterus, both by lessening pelvic hyperæmia upon which it depends and by removing the obstruction in the tubes. Care must be exercised in

acute stages, for we are dealing with a stimulant and even harmful results may follow its improper administration.

The current from the fine wire coil should be employed first. The application must always be grateful to the patient, never uncomfortable. Each application must continue until relief is experienced and sedation is produced. The application must be repeated sufficiently often to maintain quiescence, which may mean several times a day. Employed in this manner electricity may be made to take the place of opium. The patient must, of course, be confined to bed, in the recumbent posture, until the acute symptom subsides.

When the acute sensitiveness has subsided recovery will be hastened by means of the cotton-covered carbon ball electrode in the vagina, the indifferent electrode being over the lumbar region. The galvanic current may be used for five minutes before using the faradic stimulation. If the infiltration is soft, make the vaginal electrode positive; if hard, make it negative; but, as a rule, the negative is more appropriate. Twenty to fifty milliamperes may be used, according to the susceptibility of the patient.

If the current produces an aching sensation the current strength must be reduced at once. Electricity is especially serviceable when the case is one of long standing. Daily applications should be made during the first week, and later every second.

Pyosalpinx.—In purulent infiltration of the ovaries and tubes, electricity is of no avail except possibly as it may promote drainage. It is usually contraindicated, as the positive pole may cause absorption of pus. Cure by electricity seems to be out of the question.

Hematosalpinx.—Absorption may be promoted by means of the negative galvanic current, thirty to fifty milliamperes.

Hydrosalpinx.—Following aspiration, application of the positive electrode through the cavity will prevent the recurrence of the trouble.

Pelvic peritonitis.—The bipolar fine wire faradic current occasionally gives good results.

Vomiting of pregnancy is treated by passing the current through the stomach, the negative pole on the back and the positive on the stomach. Stimulate the pneumogastric nerve. Anything that will increase the pelvic circulation is beneficial. Comfort and relief usually follow each application.

Postpartum hemorrhage is treated by placing one electrode on the abdomen and the other on the back, using the faradic current.

In ectopic gestation the galvanic current will destroy the life of the foetus, thus arresting the development of gestation and promoting the ultimate disappearance of the product by absorption. It is justifiable and feasible. After a rupture nothing is gained except by an operation. Electricity can be employed with safety while in doubt, waiting to establish a positive diagnosis, and if complete absorption fail it can be removed with safety later on.

It is best to insert one electrode in the vagina and the other in the rectum beyond the tumor mass. The electrodes should be covered. The treatment may continue five minutes with a current strength according to the susceptibility of the patient.

Sterility is frequently due to an inflammation of the cervix and endometrium. An actual cure

of these conditions would undoubtedly cure many cases.

In the treatment of sterility it is necessary to correct the conditions of chlorosis and anæmia. The uterus and ovaries should be stimulated by means of galvanism and faradism in order to hasten development. The negative galvanic application to canal of the cervix twice a week for several months will alter the diseased secretions which frequently interfere with conception. If the secretions are acid these applications to uterus will correct this condition. After three months' treatment suspend treatment and watch for results. If the secretions are alkaline, use the positive pole, with platinum or carbon electrode



Block Tin Intrauterine Electrode.

in the vagina, with twenty to thirty milliamperes for about five minutes every two or four days.

Menopause—Galvanic and faradic currents have both proven successful. The faradic is most used, the current being as strong as the patient can bear it. Use on alternate days. The negative galvanic current may be used to promote absorption. The positive electrode when used should be made of either platinum or carbon.

The hot flashes, headaches and other nervous disturbances are best treated by means of static electricity. Small spark applied all over the body, as well as static insulation, acts as a sedative to the nerves.

Fibroids—The actual disappearance of a fibroid tumor seldom occurs under the use of electricity, though frequently a considerable reduction in the size of the growth may be caused, as well as a

cessation of the symptoms. Operations, being comparatively safe, should always be resorted to, unless contraindications exist. Electricity may often be employed to advantage preparatory to operative procedure to clear up exudates. Absorption of serous infiltration, fibrinous exudations, blood extravasations of pelvis, are promoted by the constant current. The positive pole is used by means of the cotton-covered carbon electrode, well moistened or soaked in glycerine.

The excessive hemorrhages that frequently accompany growths of the fibroma of the uterus are usually due to a fungoid change in the endometrium, that becomes very vascular, owing to the obstruction. This condition can generally be relieved by application of the positive electrode in the uterus. After treatment the uterus may be considerably reduced in weight.

Galvanism has no beneficial effects on fibroids that have undergone cystic degeneration, but, on the contrary, may do harm. Myomata and interstitial growths seem to be more amenable to treatment than fibroma.

In treating a fibroid growth, the electrodes must be so placed as to include the mass between them, the negative or positive pole being selected as the active electrode, according to the effects desired. The negative electrode is used in the tumor when hard and no hemorrhage is present, and a current strength of from twenty-five to one hundred and fifty milliamperes may be used. A large pole should be used on the abdomen, or it will be painful. A wet towel is a good electrode, but should be so placed as not to touch the thighs or pubes, and any wound should be covered with collodion to prevent an eschar.

For pain the fine wire faradic current may be used. The positive pole, with the constant cur-

rent and a current strength of from twenty-five to fifty milliamperes for two minutes, may also relieve the pain.

Galvano-puncture involves the risks of injuring the uterus and blood vessels, and experience shows that growths are rarely situated conveniently for puncture through the vagina. Galvano-puncture is followed by more rapid symptom amelioration and may be absolutely indicated in some cases. Electrolytic destruction is not wanted, but rather a regressive metamorphosis of the growth.

Strictest asepsis is necessary to prevent infection, which in spite of all care is frequently followed by peritonitis. In treatment of exudates into the broad ligament, the puncture must be made near the uterine wall, and should not penetrate more than one-fourth of an inch. Treatment should be given once a week, and not repeated if no impression is made.

GENITO-URINARY TRACT.

STRICTURES.

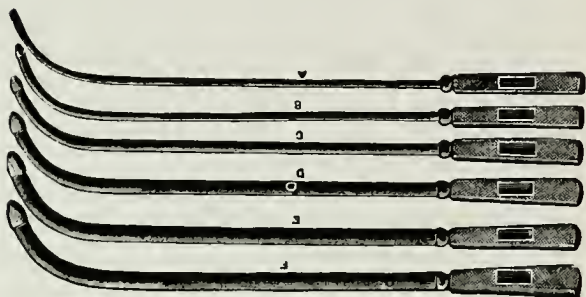
Clinical experience has demonstrated that after a few minutes' application of the cathode or negative pole to a stricture the resisting bands become less dense and less obstruction is offered to the dilating instrument. After a succession of such applications the bands are softened and rendered more yielding, and are absorbed, in part at least. Notwithstanding the time required, it is less dangerous than forcible urethrotomy and equally satisfactory in results.

Cathodal electrolysis meets the conditions necessary for relief, and has been practiced upon urethral stricture more than on any other on account of its predominance in number of cases. In urethral strictures rapid cathodal electrolysis with a strong current (twenty to thirty milliamperes) has been abandoned, and the slow method of less than five milliamperes is employed.

In cathodal electrolysis we use only mild currents with batteries from small cells containing weak fluids. A battery presenting a large surface and big cells is unsuitable, as it will cauterize more rapidly and more intensely than a caustic, and by the destruction of tissue and consequent suppuration aggravate the trouble.

Before using a sound or electrode it is well to inject an antiseptic solution into the canal. The electrode must be insulated except at the point where action is desired, and it should be coated with a lubricant which offers little resistance to

the current. Vaseline is dangerous as a lubricant, as it may enter the bladder, cake and become the nucleus for a vesical calculus. The olive-tipped electrode for treating stricture should be made of one piece, as the screw thread frequently wears out and the tip cannot be firmly attached.



Urethral Electrodes.

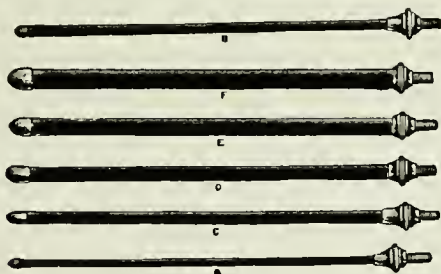
If the canal is very irritable inject a two to four per cent solution of cocaine or introduce a suppository containing—

R Extract Belladonnægr. $\frac{1}{4}$ to $\frac{1}{2}$.
 Aquæ Ext. Opii.gr. i.
 Cocoa ButterQ. S.

Anæsthetics are not used. Don't operate during the acute or subacute inflammatory condition. Only one instrument should be introduced into the urethra at each operation. For an ordinary stricture use an electrode three sizes larger than the stricture.

The olive-tipped electrode is passed into the canal until it becomes partially engaged in the strictured area. The positive pole of large surface is well moistened and kept well in place on the breast, back or hand, and the current of from three to five milliamperes is gradually let into the

circuit. The tip is kept gently in contact with the stricture until the tip of the instrument slowly moves onward past the point of obstruction. This may require from two to twenty minutes, but a longer treatment is not advisable. If the electrode passes through the stricture in a few seconds bring it back and hold it in place for a few minutes to prolong the effect of electrolysis at one sitting. It is sometimes necessary to use the same electrode for several successive treatments, as determined by the nature of the stricture. Too much should not be attempted at one sitting.



Urethral Electrodes.

Its action is slow, gradual, dissolving or disintegrating, and should be repeated at intervals of five days to two or three weeks until the size of the normal urethra is reached.

Gleet—The faradic current may be used with a preference for the positive pole in the urethra, the negative pole being placed over the lumbar plexus. The benefit arises from a stimulation of the mucous membrane and the glands. A sound may be used, but an electrode with two to three inches free and uninsulated will answer the purpose better.

The galvanic current may also be used; the

pole must be selected according to the effect desired. A current stronger than five milliamperes is apt to overstimulate and even cause inflammation and bring on a consequent discharge. Hydro-galvanism is useful when the parts are painful, but do not displace the solid metal electrode.

Vesical spasm is usually a symptom of some other disorder. Both galvanic and faradic currents have been successfully used, and either is beneficial. The positive pole is used in the urethra and the negative pole over lumbar spine. The current is slowly increased until the sound or electrode passes into the bladder. The induced current from a long coil of fine wire is preferable in the beginning.



Tunneled Electrode.

If the cause of spasm is general or central paralysis, use the galvanic current with two pad electrodes over the spine, or the anode (positive pole) over the lumbar region and the cathode (negative pole) over the bladder. Eight to twelve milliamperes may be used for ten minutes.

If the muscle of the bladder has lost its contractile power hydro-galvanism is indicated.

Local use of the faradic current to the spine is contraindicated in nervous patients.

Cystitis with painful tenesmus.

For this disease use a flat electrode under the sacrum and a carbon electrode and pad to the perineum. Through the tissues pass a circuit of twenty low tension cells for ten minutes. It is frequently surprising how quickly the pain vanishes and tenesmus is lessened.

Impotency—Associated with suggestion, static electricity is undoubtedly more beneficial than any other form of treatment. Sparks to the lumbar spine and perineum, as well as the static wave current to these parts, are indicated. Friction sparks and Leyden jar currents may also be used locally on the penis with effect.

All electrical modalities have been tried, with success in some cases and failures in others. The positive electrode may be placed on lumbar cord, the negative along the seminal canal from the lingual ring downward. The current should produce a distinct burning sensation. Then one minute labile application along the upper and lower surface of the penis as far as the glans. Finally the cathode (negative pole) may be applied to the perineum for two minutes. If the testicles are atrophic, pass the current directly through them.

Enuresis—On the supposition that the incontinence depends on the hyperexcitability of the vesical mucosa, the sedative influence of galvanism should be used. Where the trouble is due to weakness of the vesical centers in the spine, galvanism is used to increase the activity in this particular center, and where the trouble is due to a weakness of the sphincter muscles the faradic current is used, with one pole over the lumbar spine and the other to the perineum. Many brilliant results have followed this treatment where medication has failed.

In hydrocele the positive needle is inserted into the tumor. This treatment frequently prevents secretions and determines absorption.

Varicocele.—Insert a silver needle into the vein and connect it with the positive pole of the galvanic current. Apply 10 to 15 milliamperes. This procedure will bring about occlusion of the vessel,

the same as tying it would. Carried out with antiseptic precautions, it is altogether without danger.

In the treatment of *prostatitis*, acute or chronic, static electricity by means of the wave current is frequently very effective. The rectal electrode should be about five inches in length, adapted to the conformation of the glands and reaching the seminal vesicles. In patients not suffering from constipation it is well to use the insulated electrode, thereby relieving the sphincter muscle from a painful contraction which would otherwise be induced. The base of the electrode may be set either flat upon the chair or elevated at either



Prostatic Electrode.

extremity, in order to bring a proper pressure or contact with the diseased parts. The spark gap should be regulated as tolerance permits (from six to twelve inches). The use of a urethral sound of a large size may be conveniently carried to, but not into, the vesical sphincter, where it would produce a disagreeable contraction. The spark-gap here, as in the rectum, must be regulated by the sensation produced.

Galvanic electricity has been used for years by various operators, with varying success. The negative, being made the active electrode, may be applied either by rectum or urethra.

Galvano-puncture of the hypertrophied prostate (per rectum) by means of the negative platinum needle has also met with success in some cases.

Many cases will be more benefited by the electrode in this position than in any other.

The galvano-caustic method introduced by Bottini is performed as follows:

After washing out the bladder the posterior urethra is anæsthetized by means of cocaine. The instrument is introduced with the electric current broken. In order to burn a groove the concavity of the instrument is turned towards the desired spot. The instrument is slightly withdrawn, so that its concave surface will hug the prostate. The current is turned on. The surgeon waits fifteen seconds for the blade to heat and then projects the blade to the required extent by means of a screw handle. When a sufficient groove has been produced the cautery is returned to its sheath. A second and third furrow can be burned in this manner. Bottini burns three furrows, a moderately deep one towards the rectum and a deep one into the lateral lobe which is most markedly enlarged. After the furrows have been burnt the current is turned off and the instrument withdrawn. The operation requires five minutes to execute. The patient can urinate at will after the operation and can get out of bed in a few days.

The operation is not entirely free from risk, as sepsis may ensue. The operation is still on trial, as contractures are liable to occur, followed by stenosis, and render a subsequent prostatectomy an extremely difficult procedure.

DISEASES OF THE SKIN.

Electricity in diseases of the skin, as in all other troubles, acts either as a stimulant, a tonic or a sedative. Galvanic electricity is of far more value than either the faradic or static, singly or combined.

As a sedative galvanic electricity is used only with a mild current of about three milliamperes and is usually applied for about five minutes, care must be taken that the current is not broken during the application. Galvanic electricity possesses the power of improving the nutrition of the skin and thus rendering it less hospitable to many forms of organic life, and thereby tends to destroy parasitic diseases.

Acne—Electric treatment is employed rather as an adjuvant to general and local treatment. As the trouble undoubtedly arises from faulty elimination the organs of elimination must be stimulated. The following prescription, taken internally, has a decided beneficial effect on the trouble:

R Citrate Potass.	ʒi
Liquor Potass. Arsenitis	ʒii
Glycerine	ʒi
Aqua Menth. pip., q. s. ad.	ʒiv

Sig.—One teaspoonful, taken three times a day.

Before beginning electrical treatment it is first of all necessary to empty the comedones of their inspissated sebum. This is best done by means of a comedome extractor. The pustules should

also be emptied of their contents, the entire affected area washed with an antiseptic solution and then thoroughly dried.

The positive pole of the galvanic current attached to a sponge electrode may be applied over the surface with a current strength of about ten milliamperes. The current should be allowed to pass for about five minutes.

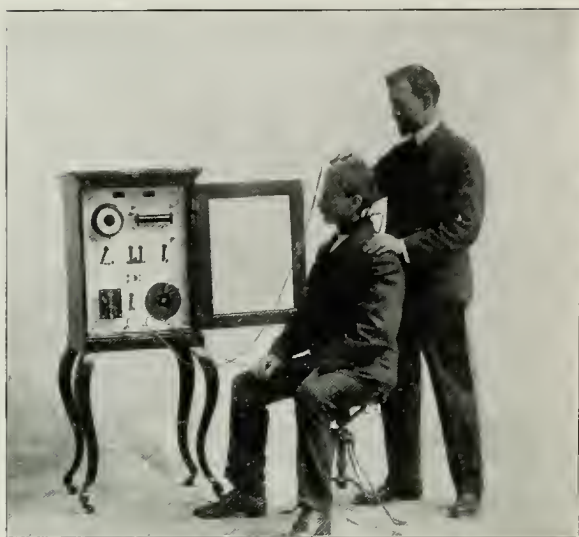
The alternate use of the negative and positive poles are sometimes productive of more rapid results than the positive pole used alone.

The use of the X-rays in acne is indicated first, because it causes an atrophy of the glands of the skin, the sebaceous glands as well as the hair follicles; and secondly, on account of its bacteria-destroying properties, thus inhibiting the formation of pus.

The X-ray should, however, not be used until all other measures have been tried and failed.

Acne Rosacea.—This disease may be treated by electrolysis of the capillary blood vessels, with the positive pole at some indifferent place and the negative a thin needle pushed into a dilated blood vessel. Where this is not possible, transfix the blood vessel in two or three places. A current from a galvanic battery of four to ten cells, with a strength of one to three milliamperes, is usually sufficient. The electrolysis is continued until the blood vessels are thoroughly destroyed, and no bleeding should follow. Three or four punctures or electro-punctures are sufficient for one sitting, and the pain on introducing the needle is slight when no current is passing. The treatment may have to be carried on two or three times a week for five or six months, and has proved satisfactory in quite a number of cases.

Alopecia.—There is no doubt of the efficacy of a galvanic current in hastening a recovery from this trouble. A large sponge electrode connected



Faradic Stimulation to Scalp.

with the negative pole with a current strength of six milliamperes may be applied until the scalp turns red.

The alternate use of faradization by means of a very fine wire brush (bristles as fine as those used in a brush for silk hats) acts as an excellent stimulant.

Thorough massage of the scalp by means of electric vibrator may also help to revive the hairs and improve their nourishment. If the hair roots, however, are absolutely dead, no amount of treatment will revive them.

Callosities of the skin, caused by pressure, etc., may be softened and greatly improved by means of the galvanic negative electricity, and

Carbuncles may be aborted in their incipency by means of the electrolytic needle or by means

of the positive galvanic current, applied for about twenty minutes with a strength of about twenty milliamperes.

Colasma, or the abnormal deposition of pigment in the skin, is frequently benefited by the use of galvanic negative electricity.

Eczema—In this multiform disease the itching, tingling and burning may be frequently relieved temporarily by means of faradic stimulation. The dry form responds rapidly to an application of the negative electrode to the parts, the current as strong as can be borne without discomfort to the patient. Apply until the parts are thoroughly reddened. Daily sessions are best and frequently bring on a complete cure in chronic cases. The positive pole applied to a weeping eczema may be equally efficacious by removing the infiltrations from the surrounding tissues. In the moist form, exposure to the blue light has in the author's experience been more successful than any form of electricity.

Remarkable results are being claimed for the X-ray therapy.

Erysipelas—Cataphoric applications of various disinfectants may be tried in suitable cases.

Freckles.—The negative electric needle applied to the superficial layers of the skin is frequently followed by a decided effect in eliminating the discoloration.

Herpes—In this affection the positive galvanic pole applied near the periphery of the nerve for ten or fifteen minutes frequently relieves the neuralgic pains.

Hypertrichosis—For the removal of hair a very fine blunt-pointed needle is used with a current of one-half to two milliamperes, with twenty-five volts or less. For the extraction of hair a low voltage is used. The sensation produced by a

current is roughly proportionate to the voltage. A small current with a high voltage is intensely painful, as is seen in static electricity, while a low voltage may be comparatively painless. From four to ten volts will do for small hairs and a larger voltage for large coarse hairs, in the less sensitive part of the skin.

The cells of the batteries are connected in series, the carbon of the one to the zinc of the next. Connect the electrodes and test the current by taking one electrode in moistened fingers and touching the other with the tip of the tongue. Some operators insert a wire from a positive pole in a glass of water, into which the patient puts



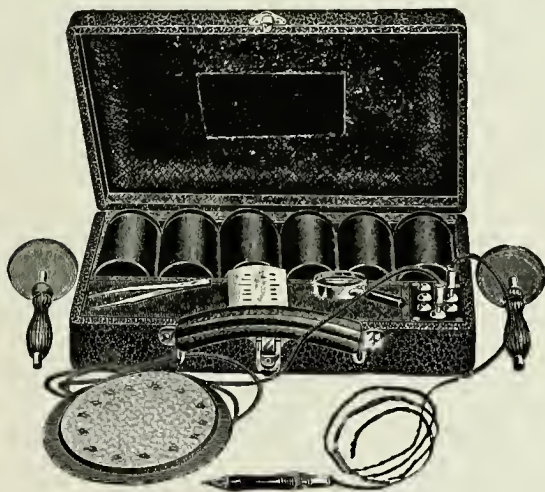
Needle Holder.

one or more fingers to complete the circuit. Others use a sponge electrode.

The needle, being fastened in the holder, is inserted gently beside the hair. The needle will glide gently down to the root of the hair and there will meet with slight resistance. Instruct the patient to grasp the electrode firmly. Cease pressure, and in ten to thirty seconds bubbles of hydrogen will appear around the needle. If the hair is destroyed it can be easily removed. The current must not be turned on before the needle is in place, nor is it safe to extract hairs that are close together. The proper method is to go over the ground, leaving three or four millimeters between. Not more than from twenty to forty hairs should be removed at one sitting. Begin with a small amount of current, say two or three cells, and increase if not found sufficient. It may

be well to have two different colors of cords, so that there will be no confusion between the positive and negative electrodes. Unless the operator's eyesight is good a magnifying glass should be used.

Hairs that were less noticeable before the treatment are sometimes stimulated to growth by this



Portable Battery for Facial Electrolysis.

method of epilation, so that it is sometimes necessary to go over the area several times.

In the treatment of fine, downy hair, treatment by electricity seems to be impracticable.

As shown by the effects of X-rays upon the hair follicles, resulting when treating other pathological conditions, hair will drop out in from four to eight weeks of exposure. The treatment should be suspended until the hair begins to reappear, when the treatment should be resumed and carried on as previously. The X-rays are not

advisable except in cases of hypertrichosis of exaggerated type. The greatest difficulty in connection with this treatment of hypertrichosis is that one must cause sufficient atrophy of the hair follicles to produce alopecia and yet do it without causing an undesirable degree of dermatitis. There is no therapeutic application of the X-rays which requires so much caution and skill as does the removal of hair, and should only be undertaken after one has had considerable experience with his particular apparatus in the treatment of other affections.

Lupus vulgaris—May be treated by means of the X-ray and high frequency current locally applied, but responds almost invariably to the Finsen Light treatment.

Pruritis, being a neurosis of the skin, may be either idiopathic, symptomatic or due to some external irritant. It may be greatly relieved in many cases by means of galvanic electricity, the poles being placed to influence the nerve terminal. Faradic electricity from the fine wire coil may also give marked relief, so also may a few exposures to the X-rays.

Seborrhea—The negative pole of the galvanic current with a moderately strong current may be used with the sponge electrode over site of the disease.

Sycosis—Responds favorably to the treatment of X-rays and the high frequency currents. Satisfactory treatments are usually obtained in most cases within a month.

Tattoo-marks of an insoluble pigment may be removed by means of electrolysis. A sharp-pointed needle connected with the negative pole of a galvanic current will excite sufficient inflammation to cause the pigment to be thrown off.

Tinea.—The cataphoric action of electricity may be made use of for the purpose of conveying medicinal substances of an antiseptic nature into the deeper layers of the skin, where these parasites make their habitat.

Chronic ulcers may be stimulated to assume a healthy condition by means of galvanic electricity. A zinc electrode connected to the negative pole should be placed over the ulcer, while the positive may be placed at some indifferent portion of the body. A feeble current is used from fifteen to thirty minutes.

Antiseptics may also be introduced into the ulcerating tissues and thus bring about a healthier condition.

Warts—The galvanic current with the positive sponge electrode with a current of from four to six milliamperes is frequently effective. The faradic current may also be used; it should be weak at first and gradually made as strong as the patient can bear it. The static spark applied to the wart is equally effective. If the wart is very prominent electrolysis as in *nævus* or the galvanic cautery may be used.

Wounds.—Needle pricks, cuts and abrasions of the surface may be readily determined by placing one hand in a basin of water in which one of the poles of the galvanic battery is placed. A smarting or burning sensation will manifest itself at the point if there is any solution of continuity. This is of advantage to a physician who is about to perform an operation upon an infected surface, enabling him to thoroughly prepare his hands by protecting the abrasions.

Angioma or nævi, if not too large, may be destroyed by means of electrolysis. The main thing to be obtained is the complete destruction of the vascular tissue and the ultimate shutting off of the blood supply to the part. The galvanic

current accomplishes this by using the positive electrode. Use a limited area and repeat at frequent intervals.

Needles set in a brass disk one or two millimeters apart comprise the proper electrode for treating *nævi*. The needles must be exceedingly fine and have very sharp points. When the skin around the needles begins to blanch and rise in wheals galvanic action is established. In twenty-four to thirty-six hours small crusts will form, and when these fall off small cicatrices will show themselves. The operation may be repeated every two weeks until the color is approximately normal.

In occluding veins care must be taken not to withdraw the needle until the clot is firmly fixed, otherwise the clot may become an embolus and cause any amount of mischief.

When desired needles connected with both poles may be introduced into the growths parallel to each other, one being positive and the other negative. The current is turned on until the tissues are blanched and the froth around the needle indicates a rapid destruction of tissue. Electrolysis must be continued until no hemorrhage takes place on the removal of the needle, and as much of the growth may be destroyed at one sitting as possible. The strength of the current is indicated by the patient's endurance, the pain being very intense at times, but usually ceases on the removal of the needle. The scar following galvano-cautery is much more marked than when electrolysis is used.

MISCELLANEOUS.

NEPHRITIS.

Whatever the cause of this disease, it may be presumed that there is some inherent or acquired weakness of the kidneys present, rendering them the weak link in the visceral chain, and that this is the real cause why they fall victims to the various causes ascribed as the active agents in producing this disease. In many cases lesions of the spine, of such a nature as to interfere with the vital forces distributed to the kidneys, are present. This explains why the poisons of acute infectious diseases frequently produce nephritis in an already weakened urinary mechanism, and why one person suffers from the disease, while similar circumstances fail to cause it in another.

Owing to the serious pathological changes that have taken place before the patient consults a physician, the treatment is directed largely to the alleviation of the manifestations of the disease, such as nausea, vomiting, headache, pain in the back, dropsy, etc. It is necessary for the relief of the symptoms to rid the system of the accumulated poisons. As the visceral organs are usually in a congested condition and frequently fail to respond to diuretics, etc., recourse should always be had to either hot air or electric light baths, which give relief to the kidneys, liver and heart. In many cases where the first sound of the heart at the base cannot even be heard, ten to fifteen minutes in the electric light bath will make it almost as plainly distinguishable as the second

sound, whose ringing character is also greatly modified. The effect frequently lasts for hours, and where treatment is persisted in daily, for a long time, the apex beat, which is outside of the nipple line, may be brought back almost to its normal position.

Vibratory stimulation of the entire spine is indicated, as the vicious circle, once established, involves all the organs.

The high-frequency current, on account of the large amount of ozone developed, is a great aid in treating this disease. Treatment should be given to the entire body for an hour, several times a day if necessary, in severe cases.

The wave current with the electrode over the liver, kidneys and spine, with a spark-gap of five to six inches, for one-half hour daily, as well as the static bath, may be given with a great deal of benefit.

DIABETES.

The influence of the general nervous system in diabetes is well known, but not understood. Lesions in the medulla, cord and sympathetic system have caused diabetes. In the floor of the fourth ventricle lies the so-called diabetes center. It is a point puncture of which results in diabetes. The effect is doubtless gotten through the vagi nerves which originate from this point. The vagi also participate in liver function.

Treatment—Stimulate the cervical spinal centers, solar plexus, splanchnic and lumbar region, restoring the function of the pancreas, liver and small intestines. Apply the wave current with the electrode over liver. The pain in the hepatic region is usually relieved almost instantly by application of the negative spray to this region. The head breeze usually relieves the headache and dizziness. Electric light baths will



Wave Current in Diabetes, Electrode Over Liver and Interrupted Breeze to Forehead.

hasten elimination and oxidation of waste. The high-frequency current is also a great aid in hastening oxidation of tissue waste.

AUTO-INTOXICATION.

In the course of all diseases we find nature trying to dispose of the deleterious or poisonous products by means of elimination, and anything that will assist in the removal and oxidation of this waste material will help to relieve the diseased condition.

The elimination of waste is most easily accomplished by means of the hot air bath, which causes elimination of waste through the skin, causes ingestion of water in abundant amount

and at the same time permits absorption through the mucous surfaces, subjecting the tissues to a veritable water bath.

Anything that will assist in the oxidation of the waste material present in the body will hasten a cure in the diseased condition. Hence the wave current with the electrode over the liver or organ involved, and positive insulations, will be most effective. Friction sparks over the entire body will also be a great aid by stimulating the integumental tissues to empty their waste into the general circulation.

When the heart is involved, positive insulation, with the active pole over the heart, is frequently very effective.

The entire lymphatic system needs stimulation, and this may be secured by stimulation of the trophic nerves which supply the glands draining the infected areas.

HEPATITIS.

Repeated attacks of congestion, if not relieved, will cause atrophy or cirrhosis of the liver. After exhausting fevers there frequently remains an impaired condition of the general system. The weak and irritable heart usually present in these disorders frequently keeps up a chronic state of engorgement of the liver.

Faradic stimulation and static electricity act in some degree as a substitute for active exercise, and frequently bring speedy relief and even complete recovery where other methods have failed.

A powerful effect may frequently be had on the sympathetic system by these currents, affecting the heart itself as well as the arterial ramifications in the liver. In using the faradic current apply one pole at the cilio-spinal center and the other at the feet or the buttocks or the solar

plexus. Electricity is of little value as long as disregard for hygienic methods of living exists.

Enlargement of the liver may follow as the result of an enlarged spleen, frequently depending on a loss of its contractility, followed by a subsequent retention of its contents. Where faradization and static electricity have failed the galvanic current is frequently of benefit.

In cirrhosis of the liver the pains are frequently temporarily relieved by electricity, which also keeps in subjection the ascites and œdematous condition of the legs.

Jaundice, being merely a symptom, frequently yields to electricity if not due to obstruction of gall duct.

It is frequently difficult to determine the exact measure of benefit derived from any special method of treatment when it is only one of a number of others that are simultaneously in use.

RHEUMATISM.

In rheumatism of special groups of muscles, the source of the discomfort is frequently found in the origin of the nerve supplying them. This is also true in chronic articular rheumatism, and the nerve supply of the limbs is almost always obstructed. The obstruction may be at the exact locality of the pain, or in the course, or at the origin of the nerve supplying the part.

In lumbago there is almost invariably some irritation of the nerve fibers supplying the muscle bundles of the erector spinæ. The causative agent of rheumatism acts by deranging the blood and nerve supply locally or generally. In inflammatory rheumatism the effect is possibly an infection, acting on the system through causes which derange the functions of the liver and kidney and also of the central nervous system.

The treatment consists principally in treating the primary cause, looking particularly to the excretion of the poisons from the system. The circulation to the part affected must be kept free.

This is accomplished by vibratory stimulation along the entire spine, and especially the tender spots, if any are present. Stimulation must also be employed along the vessels and lymphatics of the part affected. Remove the muscular contractures wherever present.

Muscular rheumatism is usually obedient, in a very marked degree, to some form of electricity. Static electricity is found the most efficacious in muscular rheumatism. It is by no means a pleasant method of procedure, but if continued for from twenty minutes to a half hour, sufferings of weeks from attacks of lumbago, etc., have been completely cured after a single treatment.

Where the pain is of a neuralgic type, with great tenderness on pressure, galvanic and faradic electricity are preferable, and one treatment will almost immediately lessen the tenderness and relieve the pain.

Acute Rheumatism—The static-brush discharge or high-frequency current for twenty to forty minutes over the seat of inflammation frequently relieves the swelling and improves metabolism in acute rheumatism.

Local applications of methyl salicylate, the affected part being afterward covered with flannel, are made very effective by static friction sparks which hasten absorption and improve the circulation.

There are some persons who are born not to be treated by electricity, while there are others who are more susceptible and respond more kindly to any form of judicious electric application. General faradization is frequently followed

by a marked alleviation of pain and the shortening of an attack.

In *articular rheumatism* the wave current over the liver and kidney will stimulate these organs to activity. This current may be applied over the affected joint with a spark-gap of from six to ten inches, or as long as it can be borne without causing painful contractions, about fifteen or twenty minutes.

Hot air or electric light baths (local or general as indicated) are an important aid in eliminating the poison. If cold is applied after the bath it must not be too prolonged or too intense, as cold water flowing directly on the joints may increase the pain.

As it is of importance to increase the nutrition of the parts, the trophic centers in the spine must be actively stimulated.

RHEUMATOID ARTHRITIS.

Electricity has been found to be a palliative to a marked degree in many cases, relieving pain and increasing mobility. The static-induced current, with the high tension, is often very serviceable, as well as the high tension faradic current, and a vigorous current sufficient to produce intense redness of the skin is sometimes followed by great relief.

When we wish to give the entire body the effect of galvanic or faradic stimulation or sedation there is no mode of treatment so well adapted to do so as the electric bath.

SCOLIOSIS.

Spinal curvatures are rarely painful, but when pain is present, the first step in the treatment is to carefully relax all spinal tissues, deep and superficial; to increase or correct the circulation in them.

Treatment—Vibration—Treat with moderately deep pressure on the side toward the deviation to relax the contracted muscles, thereby removing the irritation to the nerves consequent on contracture. Next, treat the opposite side of the spinal column to increase the blood supply to the nerves of nutrition. This will materially aid in developing tone and strength in partially inhibited muscles.

It is a good rule in spinal curvature to direct attention to replacement of the parts affected. Begin at the lowest vertebra involved and make an attempt at each treatment to replace it. A considerable degree of force is sometimes necessary to put the parts back into place, but violence must be avoided. Wave current to the spine is a great aid in improving the circulation and tone of the muscles.

CONTRACTURES, TORTICOLLIS, ETC.

Whenever an inflammatory process continues for a length of time in the structures of a movable joint in any part of the body, the group of muscles which control the action of that joint become contracted and the limb becomes fixed in extension or flexion, because long-continued irritation of the nerves induces contraction of the muscular fibers. Sparks liberally applied along the course of the contracted muscles serve better than any other means to overcome muscular contractions. Contracture may be prevented in paralyzed limb, if treatment is instituted while the muscles may still be extended by gentle manipulation and muscular shortening is not yet established. The wave current from the static machine, as strong as can be given without causing painful muscular contractions, is also useful, though not as effective as sparks.

SPRAINS AND BRUISES.

If the incandescent blue light be used shortly after the injury, sprains or muscular ruptures are greatly modified, as swelling is prevented and pain averted.

Massage and vibration of the affected parts is also very effective, as it removes the stagnant condition in blood and lymph systems. Look well to the glands draining this area.

Local light baths will aid the disappearance of the swelling in a comparatively short time. The static wave current, short sparks and Leyden jar currents are also great aids in improving the nutrition in the parts.

In the treatment of fractures the static spray or brush discharge will allay the suffering of the patient and hasten the complete recovery of the case. Sparks are not indicated, as the active contraction of the muscles before the bones are united would be apt to throw the parts out of position.

The danger of ankylosis is greatly lessened, due to the diminished congestion and more rapid repair of the injured parts.

SYNOVITIS

when not characterized by pus may be treated by means of the static wave current, spark or spray. Long percussion sparks are imperative in many cases to bring about a cure. Exposure to the blue light alone for thirty to fifty minutes has been followed by success in several of the author's cases.

GOITRE.

The positive sponge electrode with galvanic current may be applied to the surface. A large electrode should be used to permit a

considerable current strength (five to ten milliamperes). Treatments should be repeated every second day. The dispersing electrode may be held on the back. Cataphoresis may also be used, a solution of iodide of potassium being applied by means of a large electrode, the negative pole being used over the gland.

In the cystic form of goitre, electrolysis should be given the preference. The cyst, being emptied, is filled with a normal salt solution and the negative needle introduced, a current strength of twenty milliamperes being passed for twenty minutes.

ANEURISMS

of large blood vessels offer, as a rule, a hopeless prognosis, and until anodal or positive electrolysis was employed little hope of even amelioration could be held out for any. Skilled operators have succeeded by inserting a spiral coiled fine gold wire into the aneurismal sac through an aspirating needle. This wire is then made the anode, or positive pole, of a direct current of from ten to one hundred milliamperes. The cathode, or negative pole, being placed on some convenient part of the body, the current is continued until pulsation ceases and evidence is given that coagulation and solidification have taken place, which may require from ten minutes to an hour or more.

In some instances several coils of fine wire have been inserted at different points of the dilated vessel at the same sitting. Considering the inevitably fatal ending of these cases, if not interfered with, the operation is justified in suitable cases, as a sufficiently large proportion find marked relief and life is prolonged.

TUBERCULAR GLANDS.

Zinc cataphoresis may be used when the infected area is limited.

After anæsthetizing the parts to be treated (which may be done by means of an ethyl chloride spray), a puncture is made by means of a Hagedorn needle. To permit the introduction of the needle electrode a drop of cocaine placed about the end of the needle will make the anæsthetic effect more permanent.

The negative electrode may be placed over the back or abdomen and a current of from one-half to four milliamperes passed through the parts for about fifteen minutes. As a rule only one gland is treated at a time, applications being made every few days. The treatment may require months, but when cured no ugly scars will be found, as in cases where the glands have been removed.

INDEX.

	PAGE
Acne	306
Alimentary Tract	265
Alopecia	209, 307
Alternating Current Couch.....	146
Ampere—Definition	16
Amenorrhœa	287
Aneurism	324
Angina Pectoris	275
Angioma	313
Ani—Prolapsus	270
Anodal Diffusion	33
Anode—Definition of	24
Arc Lamp	207
Arthritis	321
Asphyxia	276
Asthma	275
Atrophic Paralysis	247
Autointoxication	317
Baths—Arc Light	217
“ Electric	62
“ Incandescent Light	215
Battery Fluid	12
Bipolar Electrode	280
“ Method of Faradization	280
Blue Light Treatment	210
Brain—Perverted Functioning of	249
Callosities	308
Carbuncles	308
Cancer	173
Cataphoresis	35
Anodal Diffusion	33
Cathodal Diffusion	33
Electro Cataphoric Bath.....	62
Local Anæsthesia	36
Mercuric	37
Cocaine	35
Aconite	35
Iodine	35
Cathode—Definition	24
Cells—Arrangement	13

	PAGE
Central Galvanization	250
Chemical Effect of Poles.....	30
Chorea	257
Coccygodinia	257
Coil Currents—Physiology of.....	50
Colasma	309
Conjunctivitis	102
Constipation	269
Contraction—Anodic Break	234
Anodic Make	233
Cathodic Break	234
Cathodic Make	233
Contractures	322
Current Diffusion	25
Current Flow	11
Cystitis	302
Dermatitis—X-Ray	176
Diabetes	316
Diaphragm Paralysis	263
Diarrhœa	269
Diphtheria—Paralysis of	243
Dysmenorrhœa	283
Ectopic Gestation	295
Eczema	309
Electric Bath	62
Electrodes	20-24
Electro-Diagnosis	225
Electrolysis	30
Electrolyte	10
Eneuresis	303
Epithelioma	177
Erysipelas	309
Exophthalmic Goitre	257
Facial Paralysis	246
Faradic Current	43
Faradic Brush	57
Fibroids of Uterus	296
Fissures	271
Fluoroscope	155
Freckles	309
Galvanic Current—Physiology of	26
Sedation	39
Stimulation	39
Galvano Cautery	69
Galvano-Faradic Current	60
Galvano-Puncture	298
Gleet	301
Goitre	323

	PAGE
Hallucinations	252
Headaches	254
Hematosalpinx	295
Hemiplegia	253
Hemorrhoids	270
Hepatitis	318
Herpes	39
Hiccough	201
High-Frequency Currents	130
Hydrosalpinx	295
Hughes Ionizer	109
Hydrocele	303
Hypertrichosis	309
Hysteria	258
Illumination	74
Impotency	303
Induced Current	43
Infantile Paralysis	239
Insomnia	261
Intercostal Neuralgia	257
Iodine Cataphoresis	35
Jaundice	319
Laryngitis, Chronic	126
Lead Poisoning	264
Leyden Jars	81
Leyden Jar Currents.....	124
Light, Physiology of	203
" Therapeutic Employment of.....	209
Liver	318
Locomotor Ataxia	127, 259
Lumbago	112
Lupus Vulgaris	312
Magnet	72
Measurements	16
Menopause	296
Menorrhagia	287
Mental Disorders	252
Menstruation	283
Mercuric Cataphoresis	37
Metritis	292
Milliamperemeter	18
Nævus	209
Neuralgia	255
Nephritis	315
Neurasthenia	65
Occupation Neuroses	126, 259
Esophagus—Stricture of	265
Ohm's Law	17

	PAGE
Ovarian Congestion	285
“ Neuralgia	287
Ovaritis	286
Paralysis—Atrophic	247
of Diaphragm	263
Diphtheritic	243
Facial	246
Lead	264
Pelvic Disorders	278
Penetrometer	170
Pharyngitis	126
Poliomyelitis—Acute	241
Post-partum Hemorrhage	295
Prolapsus Ani	270
Prostatitis	304
Pruritis	312
Pyosalpinx	294
Psychic Disorders	253
Rheostat	18
Rheotome	19
Rheumatism	64, 126, 319
Roentgen Rays	148
Rhinitis	68, 272
Rhumkorff's Induction Coil	149
Salpingitis	293
Sciatica	256
Scoliosis	321
Seborrhœa	312
Sinusoidal Currents	75
Solenoid, Auto-induction	134
“ Alternating Current	144
Spinal Disorders	236
Static Electricity	78
Apparatus, Care of	89
Physiology of	82
Static Electricity, Modes of Application—	
Insulation	97
Breeze	99
Spray	102
Spark	111
Wave Current	119
Leyden Jars	124
Sterility	295
Stricture of Œsophagus	265
“ Rectum	271
“ Urethra	299
Stomach—Atony	268
“ Dilated	268

	PAGE
Stomach—Hyperæsthesia	266
Subinvolution	289
Sycosis	312
Synovitis	323
Tattoo Mark	312
Tinea	313
Tinnitus Aurium	272
Tonsillitis	273
Torticollis	322
Trauma	248
Tracheotomy	273
Tuberculosis	97, 200
Tubercular Laryngitis	274
“ Glands	324
Ulcers, Chronic	313
Urethritis	66
Urethra, Stricture of.....	299
Uterus, Infantile	283
Displacement	290
Metritis	292
Endometritis	291
Cervical Endometritis	291
Catarrhal Endometritis	293
Septic Endometritis	292
Senile Endometritis	293
Post-partum Hemorrhage	295
Fibroids of	297
Varicocele	303
Vesical Spasm	302
Voltage, Definition of.....	16
Voltaic Cell	10
Vomiting of Pregnancy.....	295
Warts	313
Wounds, Detection of.....	313
Vibratory Stimulation	179
“ “ Table for	202
X-Rays—Apparatus	148
Tubes	157
Aid in Differential Diagnosis.....	166
Vocalization of Fractures and Dislocations	163
Therapy	172

Date Due

YALE
MEDICAL
LIBRARY

Demco 293-5

NM 0

904 0

